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THE ALTOONA SHOPS OF THE PENNSYLVANIA RAILROAD.

V.

(*Continued from page* 245.)

In the last article on the Altoona shops the principal features of the Gölsdorf and Von Borries compound engines, with which the Pennsylvania Company is experimenting, were illustrated and described. It remains to explain the construction of the other two engines.

THE "PITTSBURGH" SYSTEM.

The general features of construction of this engine are shown by Fig. 1. Figs. 2 and 3 are sectional views of the intercepting valve, which is located between the cylinders. In Fig. 2 the valve is shown in the position it occupies when the engine is working simple. Steam from the boiler can then enter the steam-chest of the high-pressure cylinder through the passage *N* and to the receiver and low-pressure cylinder by the passage *K*. When the parts are in the position shown the steam in *K* moves the reducing-valve *C* from its seat and thus allows steam to flow from *K* into the passages *O* and *P*, as indicated by the darts, and thence to the receiver and low-pressure cylinder. When the intercepting valve *A* is in the position shown, the passage *Q*, which communicates with the exhaust of the high-pressure cylinder, is connected with *M*, which leads to the atmosphere. The high-pressure cylinder thus exhausts directly into the chimney and the low-pressure cylinder is supplied with live steam from the passage *K*.

To change the engine so as to work compound a cylinder *E*, Fig. 1, is placed on the position shown. This cylinder has a piston which is connected by a rod *F* to a double-armed lever *G*, the lower end of which is connected to the intercepting valve stem *H*. Inside of the cab a double-armed L-shaped lever *D* is provided, the horizontal arm of which has a slot in which a pin on the reverse lever works. This slot has depressions at each end so that when the reverse lever is at its extreme throw in either direction the horizontal arm of the lever *D* will be raised up by a spring *S* at its back end.

The upper end of the vertical arm of this lever is connected to a valve on the cylinder *E*. The throttle lever being open when the reverse lever is thrown backward from its extreme forward position, it acts on the lever *D*, and moves the valve in the cylinder *E*, so as to admit steam to its front end and exhaust it from the back end, thus forcing the piston backward and causing the intercepting valve *A*, Fig. 2, to move forward into the position shown in Fig. 3. This movement first closes communication from the high-pressure cylinder exhaust passage *Q*, and the passage *M*, which leads to the chimney and opens communication from *Q* to the passages *P*, which leads to the receiver and low-pressure cylinder. The steam from the high-pressure cylinder instead of exhausting up the chimney is thus discharged into the receiver and low-pressure cylinder. The movement of the valve *A* causes the piston *B* to come in contact with the valve *C* and thus closes it and shuts off steam from the passage *K*. The engine then works compound.

THE "RICHMOND" SYSTEM.

Figs. 4, 5 and 6 illustrate the chief features of construction of the "Richmond" system. They are similar to the views of the Pittsburgh engine. To work the Richmond engine simple, the

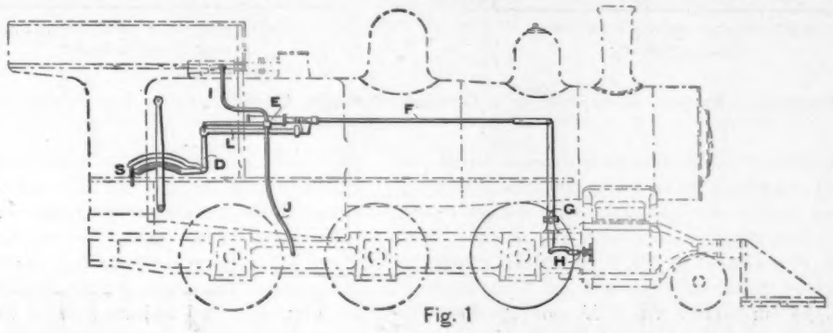


Fig. 1

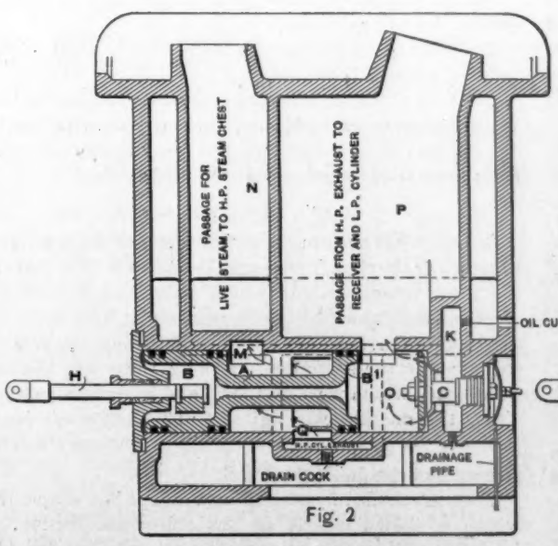


Fig. 2

POSITION OF VALVE WHEN ENGINE IS WORKING SIMPLE

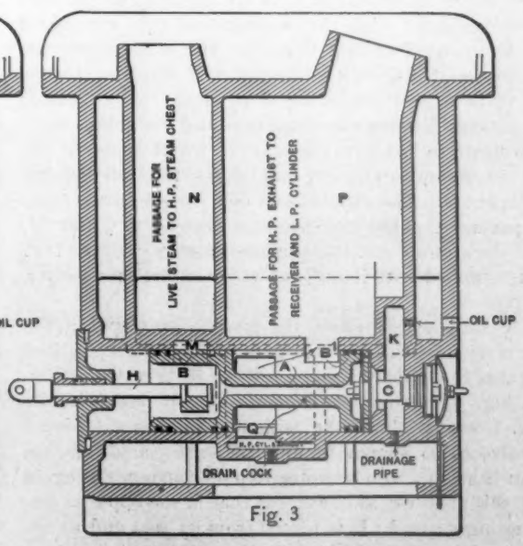


Fig. 3

POSITION OF VALVE WHEN ENGINE IS WORKING COMPOUND

Pittsburg System as applied to a Mogul Locomotive by the Pennsylvania Railroad.

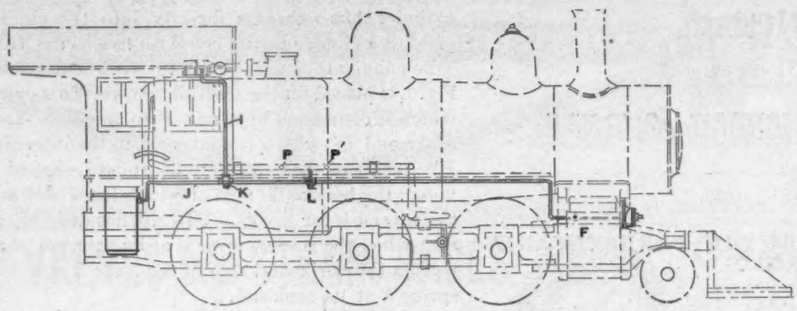


Fig. 4

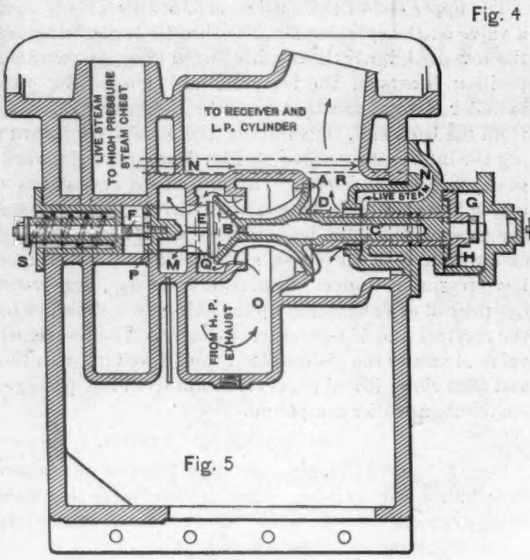


Fig. 5

POSITION OF VALVE WHEN ENGINE IS WORKING SIMPLE

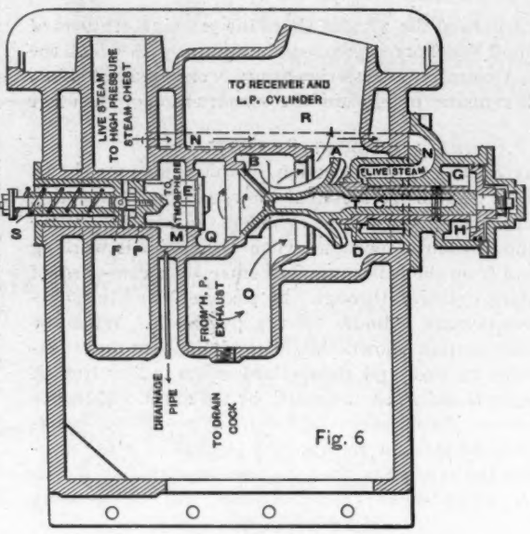


Fig. 6

POSITION OF VALVE WHEN ENGINE IS WORKING COMPOUND

The Richmond System as applied to a Compound Mogul Locomotive by the Pennsylvania Railroad.

throttle valve is opened and the reverse-lever thrown either full gear forward or full gear back. When this is done one of two tappets *P*, *P*¹ Fig. 4, on the reverse rod engage with the lever of the operating valve *L*, which admits compressed air or steam by a pipe to the chamber *F*, indicated in Fig. 4 and shown clearly in Fig. 5. The pressure of the air or steam acts on the piston *P*, Fig. 5, attached to the emergency valve *E* moving them forward and opening communication between the chambers *M* and *Q*. As *M* communicates with the atmosphere, this movement allows the steam in *M* and *Q* to escape, and thus relieves the pressure in the chamber *Q* back of the piston *B* attached to the intercepting valve *A*. At the same time steam which passes through the passage *N* opens the admission and reducing valve *D* and allows steam to flow into the space *R*, which leads to the receiver and low-pressure cylinder, and closes the intercepting valve *A* and opens *B*. The exhaust can now escape direct from the exhaust passage *O* of the high-pressure cylinder to *Q* and *M*, and thence to the atmosphere, and the low-pressure cylinder is at the same time supplied with live steam which enters the receiver through the pipe *N*.

To change to compound working, the throttle being opened, the reverse lever is withdrawn from its full forward or back positions which disengages the tappet *P* or *P*¹, and the lever of the operating valve *L*, Fig. 4, cutting off the steam or air supply to the cavity *F*, Fig. 5, which allows the action of the helical spring *S* to close the valve *E*, as shown in Fig. 6. At the same time the exhaust steam from the high-pressure cylinder accumulating in the cavity *O*, this pressure soon exceeds that in the opposite side of the intercepting valve *A*. It is forced from its seat and at the same time closes *D*, and thus shuts off the supply of live steam to the low-pressure cylinder through the passage *N*, and opens communications between the passage *O*, or from the exhaust of the high-pressure cylinder to *R*, and to the receiver and low-pressure cylinder, so that the latter then gets its supply of steam from the receiver, and the exhaust of the other cylinder, thus changing the working of the engine from simple to compound.

The sleeve of the valve *D* has an axial movement on the stem *C* of the intercepting valve and by reason of the difference of area of the end of the sleeve and the shoulder cap *T*, the sleeve acts as an admission and reducing valve to the low-pressure cylinder, when starting and when working simple and equalizes the pressure in the two cylinders.

The function of the valve *B* is to insure a quick closing of the valve *A* when *E* is opened.

The tests of the experimental compound engine in the Pennsylvania road are now completed, and have shown a decided advantage for the compound system, but the data and conclusions drawn from these tests have not yet been made public.

CLASS L PASSENGER LOCOMOTIVE.

Reference has been made several times in these articles to what is known as the class L passenger locomotives. These are built from the most recent designs which have been evolved on the mechanical department of the Pennsylvania Railroad. The accompanying engravings show some interesting features in the construction of these engines. Among these are the guides and cross-heads which were designed, and have been patented by Mr. Vogt, the mechanical engineer. Their external appearance is shown in the perspective view of the engine and the details of construction of the guides by Fig 8.

These are made of cast-iron and are of box shape, the form of which is shown clearly by the transverse section. They are joined together on the vertical center-line and bolted by transverse bolts as shown. Strong ribs on the back give vertical stiffness, and their form gives all the horizontal rigidity required. The cross-head is shown in the same figure and is made of cast

Fig. 7.—Class L Passenger Engine, Pennsylvania Railroad.
F. D. CASANAVE, Genl. Supt. Motive Power. A. S. VOGT, Mechanical Engineer.

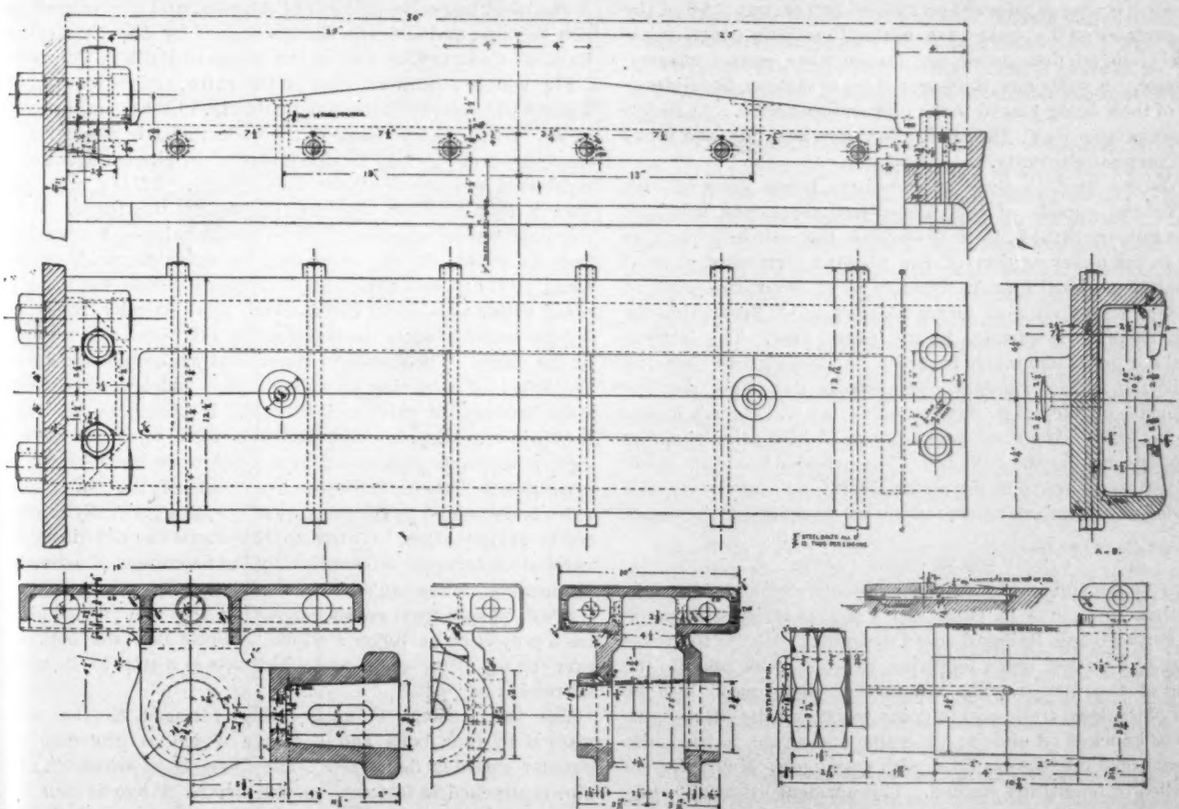


Fig. 8.—Vogt Guide and Crosshead for Class L Engines.

steel, and has been designed so as to be as light as possible. It weighs, including the pin, 146 pounds. To get a measure of its weight, the total maximum pressure on the piston is divided by this weight. The resulting modulus, as it may be called, is 340.6 pounds. In many cases in the older engines, this is 158.7. Of course, the smaller this modulus is, the heaver is the relative weight of the cross-head. The importance of making all these parts as light as possible is now recognized by all designers of locomotives. It will be seen from the engraving that the cross-head illustrated has a wide bearing on top and against the under

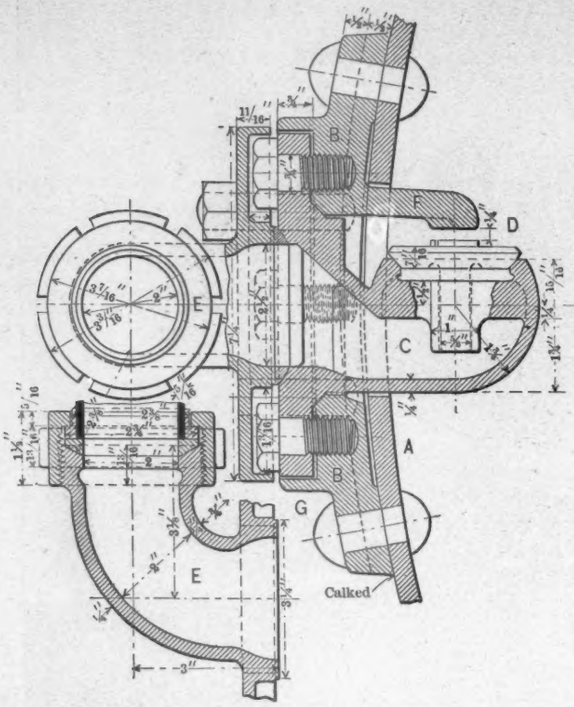


Fig. 9.

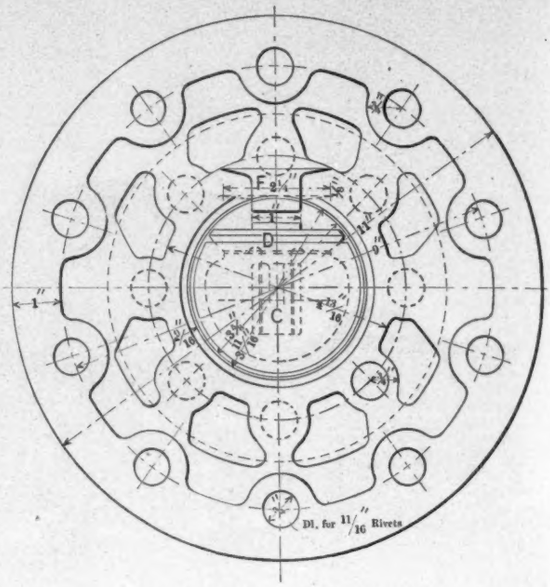


Fig. 10.

Wright's Safety Boiler Check.

side of the wearing surface of the guides. In running forward, the pressure is always upward on this wide bearing. All of the sliding surfaces of the guide are covered with tin ¼ inch thick The steel slides are first planed, and the tin when melted adheres, to the steel. A sufficient thickness of tin is cast on the slides to permit of their being planed to the proper dimensions. As shown in the perspective view, the design is a very neat one, and it has worked very satisfactorily.

The pistons used in these engines have heads made of cast steel. To the outside of this a cast-iron piston ring is bolted. This has grooves turned in it to receive the cast-iron packing rings. In the under portion of the piston a segmented piece of an ⅂-shaped sectional form is fitted so as to cover the joints of the packing rings. It also serves the purpose of preventing the packing rings from turning in the piston ring. The latter is widened out on its under side in order to give a greater bearing on the bottom of the cylinder. This permits the upper portions and the sides of the rings to be made narrower. By this means the stroke of the pistons has been increased from 24 to 26 inches without lengthening the cylinders. The cylinder heads are made to conform to the shape of the piston heads, and suitable cavities are made in the heads to receive the wide bearing of the piston ring.

SAFETY BOILER CHECK-VALVE.

It may be remembered by some of our readers who are no longer young that, some 10 or 15 years ago, a serious accident occurred on the Pennsylvania Railroad near Pittsburgh. A local train was standing at a station and a following express train ran into the rear end of the former. The locomotive "telescoped" into the last car of the local train, and in doing so one of the check-valve cases was knocked off and the hot water and steam in the boiler was discharged into the car filled with passengers. Many of them were killed or frightfully scalded. This accident led to the adoption of a check valve located inside of the boiler, so that in case of collision it would not be injured.

The first form which was extensively used consisted of a flap-valve, an engraving of which is published on page 219 of the revised edition of the "Catechism of the Locomotive." Experience showed that this form of valve was open to some objections, which led to the design illustrated herewith. This was made, and has been patented, by Mr. William Wright, chief draftsman in the machinery department at Altoona, and is now used on all new engines, and has been made standard by the Pennsylnania Railroad Company, as well as the Southern Railway Company.

Fig. 9 gives a sectional view of the valve, and its seat drawn in a plane transversely to the boiler, and Fig. 10 is a side view looking at the valve from the inside of the boiler; also in the lower left-hand corner of Fig. 9 is a sectional plan of the pipe connection. *AA* represents a portion of the boiler plate. *BB* is a brass flange riveted to the boiler plate and calked on the edges. It has a circular central opening to receive the valve-seat or casing *C*. This, as shown in the engraving, has a flange outside, which is bolted to the riveted plate, and a valve-seat inside the boiler provided with a mushroom valve, which acts vertically, thus allowing the water to enter the boiler at the valve-seat, and all around its periphery. The stream of water thus washes the seat and has the effect of removing any obstructions which might otherwise lodge between the valve and its seat. It should be understood that injectors all have check-valves of their own, and therefore there is the same pressure above and below the boiler-check, and, consequently, when the injector is shut off, the boiler check-valve is not seated by the pressure above, as is generally supposed, but by gravity alone. Owing to this cause the old hinged flap-valve often becomes inoperative by the deposition of sediment or incrustation on the hinge.

It will be seen from the the engraving that the riveted plate *B* has a projection or finger *F* which projects into the boiler and over the top of the valve, and which acts as a stop to its upward movement or "lift."

The valve-casing *C* is securely fastened to the riveted plate *B* by four bolts and a flange which is protected by a circular guard or flange *GG*. The elbow *E* to which the feed-pipe is attached is fastened to the riveted flange by four studs. The valve and its seat, which would be the source of danger if broken off in a collision or other accident, is thus very securely fastened to the boiler, is all under the jacket, and as close to the boiler as possible, the only projecting portion being the pipe elbow, which is made very light at its juncture with the flanges, so that if it is broken it will not at the same time break any of the parts to which it is attached.

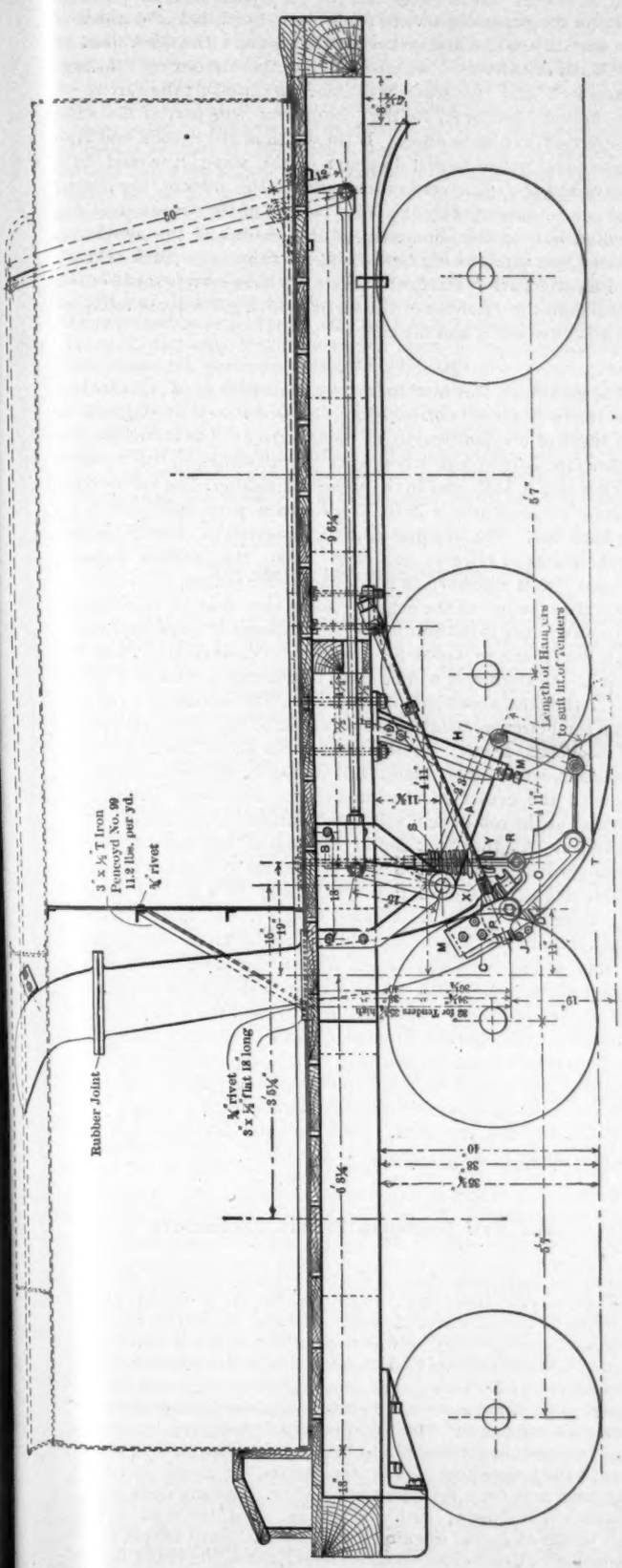


Fig. 11.—Kiesel's Balanced Tender Scoop.

The flange on the elbow projects partly into the jacket, to make a good finish, and on being removed the valve-casing can be taken out through the opening in the jacket and that in the riveted plate. Neither the jacket nor any other parts need be disturbed to take out the check valve, which can thus be readily cleaned as required.

All the parts excepting the studs, bolts and nuts are made of brass, and as light as is consistent with the required strength.

These checks have been applied to about 200 locomotives so far, and, it is said, have given entire satisfaction. In view of the terrible accidents which may occur from the breaking off of an ordinary check valve, the use of some such device as this should be made compulsory on railroads, and such a simple appliance being available, railroad managers incur a grave responsibility if they do not use it.

BALANCED TENDER SCOOP.

Tender scoops, in use heretofore, although answering the purpose for which they were intended primarily, still had one objectionable feature which became more and more apparent with the increased speed of the past few years. This defect consists of the necessity of slowing down to take water from the track trough, thus causing loss of time; also, it was necessary that a definite speed be reached; for, if the speed was too slow, it became necessary to hold down the dipper by means of the operating lever and, if too fast, the dipper could scarcely be raised, even though both engineer and fireman exerted all their strength to do so. Twenty-five miles per hour is about the greatest speed at which such scoops could be raised from the trough, and then if the dipper did not yield at the first pull, it would be dragged over the end of the trough and the mouth of the dipper was thus liable to be crushed. In consequence, it was necessary to constantly repair or replace the dippers.

The tender scoop illustrated by Figs. 11 and 12, on which letters patent have been granted to W. F. Kiesel, Jr., connected with the Mechanical Engineer's office, at Altoona, Pa., was designed to overcome this objection, the aim being to make it as efficient and easily operated at the greatest attainable speed as when running slowly.

The dipper proper, that is the portion extending from *D* to *E*, Fig. 11, is carried on pivoted supports or bolts *T*. The upper part of the dipper is connected to the up-take pipe *M* by an intermediate section *J*, which is supported on the pivots *P*. It is connected to the uptake pipe *M* by a semi-circular joint which is indicated by a dotted line. The short section can therefore turn about the pivot *P*, and can move in contact with the pipe *M*. The junction of the dipper with *J* is of a segmental form drawn from *T* as a center. The dipper can therefore turn about the pivot *T*, and can move in contact with *J* on the segmental joint. It will thus be seen that the dipper is balanced on the pivots *T* attached to brackets *O*, which are cast on and form a part of the intermediate section *J*.

The top of the dipper is open to a point immediately above the pivots *T*, so that any spray or wave may be carried up with the larger body of water.

The intermediate joint *J* of conduit is pivoted at *P*, and is held by cheek pieces *C*. The cradle itself is attached to two rods *RR*, passing through two light spiral springs *SS*, which are compressed when the dipper is lowered. These springs are set on a yoke *Y*, fixed to the frame of the tender by means of bolts *BB*, and serve only as a balance for the weight of the dipper and other movable parts when the dipper is not in use, so that, if anything should give way, or a pin be lost, the dipper would not drop to the track and possibly cause damage.

The nuts *NN* at the top of the springs project partly inside of the coils and form a definite stop and also a convenient mode of adjusting the position of the mouth of the dipper.

The hanger *H* with adjustable set screw *M* is simply a safeguard against any springing of the tender frame or arm *A*, which would result in lowering the mouth of the dipper in the trough, and a possibility of scraping along the bottom.

When water is flowing into the tender, it exerts a certain pressure on the dipper, which increases with the speed of the engine.

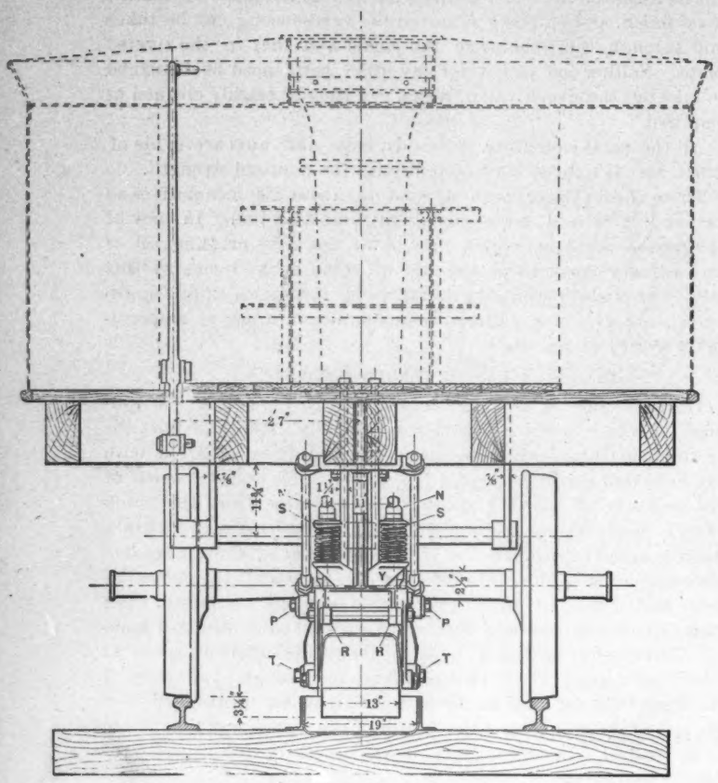


Fig. 12.—Kiesel's Balanced Tender Scoop.

Therefore the dipper is pivoted near its center, so that the pressure in the upper half balances that in the lower half. This makes it entirely independent of speed.

In lowering the dipper the only resistance is that due to the springs *S S*. In raising it out of the water the pressure on the trunnions *T* holds down the cradle and the dipper moves round the trunnions *T* until the stops *X X* touch the arms of the cradle. This gives enough motion to the dipper to allow the mouth to rise clear of the water, consequently no more water rushes in and the rest of the movement takes place easily around the pivot *P*.

Lowering and raising can be easily occomplished with one hand at any speed.

The first scoop built was in continual service for eighteen months without costing anything for repairs. For the past two years the Pennsylvania Railroad Company has been equipping all new tenders with this scoop, and there are now more than seventy-five in service. They are giving excellent satisfaction and are very much liked by the engineers, who claim that they can fill their tenders in much less distance than with the old scoop, and besides this they are not obliged to slow down to take water as was the case formerly. They can therefore more easily make up lost time.

Before adopting this scoop, the Pennsylvania Railroad Co gave it a thorough trial, and found that it proved superior in all respects to anything in that line before used. It has also been proved that with this scoop less water is wasted by being sprayed or thrown out of troughs, that the cost of repairs has been materially decreased and more water per hundred feet run is delivered into the tank. Running at 70 miles per hour a 3,000-gallon tender was filled on a trough 1,000 ft. long in nine seconds.

Before these scoops were adopted it almost became necessary to either increase the length of troughs or use more of them, because it was nearly impossible to fill the tanks with the old scoops when used in connection with the larger locomotives. Now there is no difficulty in this respect, even when running double-header engines. The Pennsylvania Railroad Co. is also equipping their new mogul fast freight engines with this balanced scoop in order to be able to run through without stopping or even slowing up to take water.

FIREBOX.

From the perspective view it will be noticed that the sides of the firebox are of a somewhat peculiar form. The back part of the waist of the boiler where it joins the firebox is of large diameter, and it was desirable to make the front of the firebox conform to the contour of this part of the waist where they join each other. If the width of the firebox had been made equal to the largest diameter of the waist it would have contracted the space very much between the sides of the firebox and cab. Consequently the front portion of the firebox steel was swelled out to the diameter of the shell, and the swell was carried by a diminishing taper from the front to the back. The tip or Belpaire part of the firebox shell it will be seen is made of less width than the diameter of the waist, which gives more room for outlook between it and the cab.

VALVE GEAR.

The maximum throw of the valves of these engines is six inches, the throw of the eccentrics being 5½, the difference being due to the effect of unequal length of rocker arms. The valves have 1⅛ inches lap, $\frac{1}{16}$ inch lead when working full stroke in the forward motion and $\frac{3}{32}$ inch lead in the backwark motion. The valves have $\frac{1}{16}$ inch inside clearance in the front steam port and ¼ inch on the back one. The unequal clearance is given in order to equalize the points of release, and thus make the engines exhaust "square," as it is termed in roundhouse vernacular.

Another feature of the construction which may be commended in those engines is the admirable arrangement of steps and handholds which are provided for the men. Commencing from the front of the engine, it will be seen that a step is attached to the side of the pilot about half way between the bottom and the top, and a semi-circular hand-rail is attached to the lower portion of the smokebox front. Another step is placad to the side of the smokebox, with a short hand rail above it, and on a horizontal line with the center of the smokebox. The usual hand-rail is provided at the top of the boiler, and extends to the front of the smokebox. At the back end of the engine two steps of liberal size are provided, which are held in suitable box-shaped guards. Similar steps are attached to the front and back end of the tender. Over each pair of these steps long vertical handholds are placed, which are within convenient reach from the ground. The step at the back end of the tender is a new feature, and a very excellent one. With all the care that can be taken, and with all the appliances which can be provided, the occupations of locomotive engineers and firemen are still frightfully dangerous, and there is no excuse for omitting such comparatively inexpensive attachments as have been described. Nevertheless they very often are omitted, or are wretchedly inadequate for the purposes for which they are intended. Such omission or neglect is criminal, and ought to be punishable in some way.

(*To be Continued.*)

The New Heilmann Electric Locomotive.

The *Revue International de l'Electrite* is unsparing in its criticisms of the new Heilmann locomotive. From a recent article translated by the *Electrical Review*, we take the following: The Heilmann locomotive, which was tried in 1893 on the Western Railway of France, has now been constructed or is now re-constructing, of a size to develop 1.350 horse-power. Improvements suggested are better suspension of the motors, a new type of steam engine, and modified driver's apparatus. The boiler is to be of ordinary locomotive type. The heating surface will be 180 square metres (1,937.5 square feet), and the grate surface 3.3 square metres, or about 35 feet—a pretty large area for a European locomotive. The engine is to be a Williams and Robinson, with six cranks. The Heilman scheme simply brings electrical working into contempt, for it cannot prove an economy. It carries an immense boiler and a six-crank steam engine, and its one advantage is that in going uphill the steam engine can be run at speed, and will not therefore lose power, as is now the case with a locomotive, which as it travels slower, also revolves slower, and loses power

thereby. But this is to some extent a fable. When a locomotive mounts a hill it revolves more slowly, and, therefore, gets more pressure, and for an occasional hill it is not usually necessary to take along the whole roundhouse. However, our readers may judge for themselves. The two generators, of a pressure of 450 volts, are excited by a dynamo, driven by its own 28 horse-power engine, the motors are fixed to the frame of the bogies, and have an elastic connection with the axles. The power is 1,000 horse power at the rail. The drawbar pull is a little under half the cylinder output. The tyre pull is about 75 per cent. of the cylinder indication, so that: of 1,000 horse power, 250 is lost in the transmission and 250 in the engine considered as a carriage, and the new engines are to be capable of hauling 350 tons at a speed of 100 kilometers about 80 miles). It is thought that at present the advantage as to coal consumption rests with the ordinary locomotive The first Heilmann engine weighed 115 to 120 tons, and only developed 450 horse power, but the new machines are to develop 1,000 at the rail, and apparently only weigh 120 tons, or at the rate of 100 kilograms per horse power, as compared with the weight of torpedo boat machinery only 16 kilograms per horse power, a comparison of little moment, however, considering the difference of conditions It is expected that these new moving stations will be ready for trial at an early date. We do not doubt that the locomotive will run; that it will do so at a high speed; that it will haul good loads; that it will be a hill climber. We may admit all this, and more; and we think we shall still be free to paraphrase a famous French saying and repeat, "It is magnificent, but it is not engineering."

The Bates Thermic Engine.

For a year or more brief notices have appeared of a new gas motor that was to do wonders, but an air of mystery surrounded it, until a few weeks ago, when a 100 horse-power engine was put on exhibition in Philadelphia. This engine, known as the Bates Thermic engine, is of the vertical type, and has two single-acting cylinders 15.75 inches in diameter and 15.75 inches stroke, and has been run at various speeds up to nearly 200 revolutions per minute.

The cylinders are in three sections, one above the other. The lower one is the barrel, in which the piston and its packing slides; this is kept cool by a water jacket. The section immediately above this is the space in which the gas is burned, expanded and made to perform its work on the piston. The water from the jacket of the lower section rises into the jacket of this one and controls its temperature. The circulation of water is so slow, however, that it turns to steam before it leaves the jacket of the third section, in which the admission and exhaust valves are placed, and which forms what might be called a valve chest.

The exhaust gases from the cylinders pass into two regenerators, which take the place of one side of the A frames which usually support the cylinders of a vertical engine. In these regenerators the exhaust parts with a portion of its heat to compressed air forced through it by a horizontal compressor driven from the crank shaft. Part of this compressed air is used in the combustion of the gas in the engine cylinders, while the remainder of it goes to a gas producer standing behind the engine. Here it is joined by the steam generated in the jackets of the engine cylinders and passes up through the fuel, making a kind of producer gas, called "Gardie" gas after the inventer. The gas is generated under a pressure of about 70 pounds and is led through a "dust separator" to the throttle valve of the engine, from whence it goes to the cylinders.

Each cylinder has three valves in the top head, one for gas, one for air and the third for the exhaust. These three valves are all of the poppet type and are operated by cams on a horizontal shaft extending across the tops of the two cylinders and driven by bevel gearing and a vertical shaft, which in turn is driven by the main shaft. The governor, acting on the admission valves only, is of the ball type and is said to give perfect regulation. The variation in speed is very perceptible, however. It should be said that the gas is not exploded in the cylinder but burns as it enters until the admission valves close, when it expands as in the steam engine. The indicator card thus resembles those taken from a steam engine, rather than the ordinary gas-engine cards. The initial pressure is under 100 pounds.

From this brief description it will be seen that this engine is simply a gas engine fitted with a regenerator and a gas-producer. There is nothing mysterious about it and its advantage over other gas engines, if it proves to have any, will be in the fact that a part of heat lost in the jacket and exhaust of other gas engines, is utilized in this one. This is certainly a desirable object to attain. The resulting economy in this case has not been great, however, as the coal consumption under test is about 1.3 pounds of coal per horse-power per hour, a figure which has been beaten by well-designed gas engines of the common Otto-cycle.

As already stated, the main shaft drives an air-compressor for furnishing air to the gas-producer and the main cylinder. A small water pump is also driven from the main shaft to supply water to the cylinder jackets. In order to start the engine after it has become cold, a steam boiler and an independent air-compressor must be employed to furnish steam and air, until the producer is in running condition, or for say nearly one hour for a 100 horse-power engine. A very small dynamo is also needed to heat two thin plates in each cylinder, which are employed to ignite the gases, but which keep hot enough for that purpose without an electric current once the engine is started.

It will thus be seen that a rather formidable array of machinery is needed, and it is not clear where the saving is to come in over a good gas engine with an independent gas producer, in the operation of which the heat of the jacket and exhaust is in some measure saved by regeneration in one form or other. In fact this type of engine is somewhat handicapped by the fact that everything is under pressure, even the production of gas, and the air needed for this process must be compressed to 70 pounds pressure. The net output of this particular engine is 100 horse-power but it generates about 140 horse-power, of which 40 horse-power is used by the compressor.

Communications.

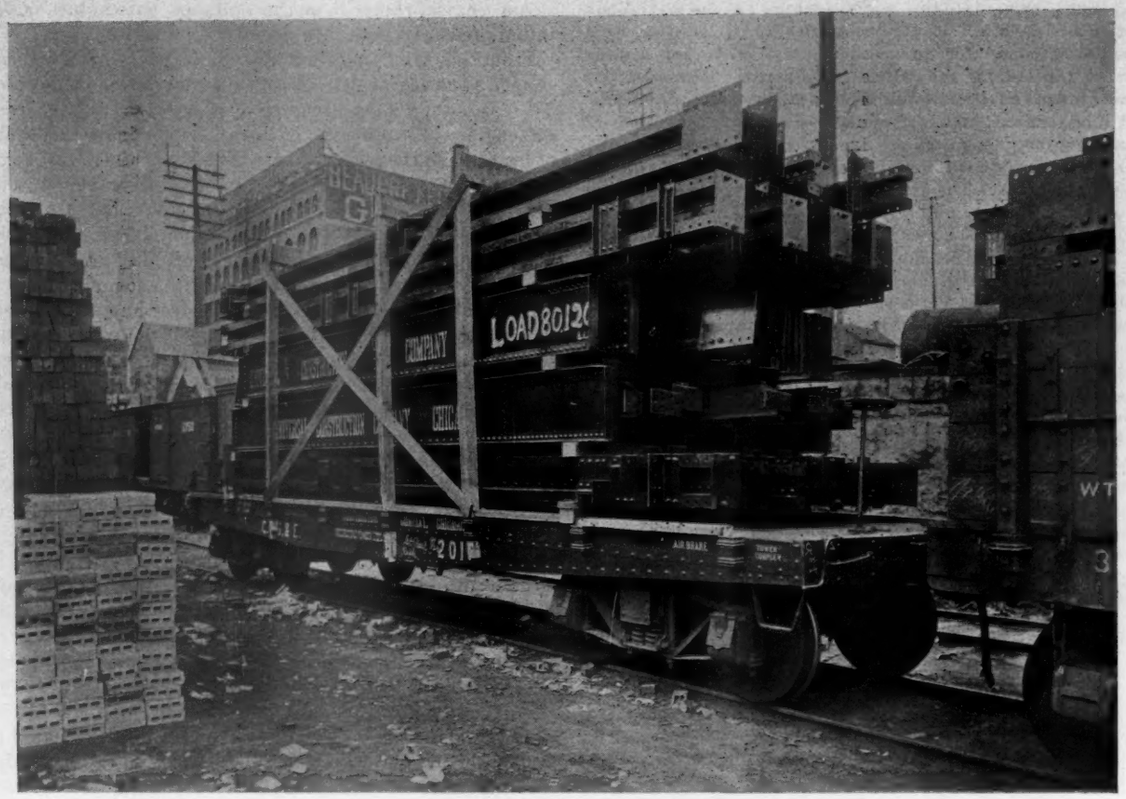
Metal Cars in France.

EDITOR AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL:

Mr. Tolmer's article on the results of from twenty to thirty years' experience with metal under-frames for cars on the Eastern Railroad of France, published in your August issue, is of great interest and value to American railroad men.

The writer has recently had occasion to examine metal under-frames of a number of locomotive tenders formed principally of heavy angle iron, and which had been in service from five to eleven years. Even in this comparatively short period the angle irons forming the sills and crossties were very badly rusted, many of them fully as bad as the section shown in Mr. Tolmer's article from cars that had been in service over twice this length of time. It was found also that the corrosion occurred almost entirely in those portions of the sills which are exposed and not covered by attaching other members of the frame to them. At these points comparatively little corrosion had taken place. The cause of this condition was, of course, due to the exposed parts not being kept covered with paint. Had they been kept thoroughly painted, I have no doubt they would still be in almost their original condition. The very excellent results obtained from metal under-frames on the Eastern Railway of France is undoubtedly due to their being carefully protected by paint, which is renewed at sufficiently frequent intervals to keep the surface well covered. There is no doubt that there are many places in metal under-frames that are difficult to reach with a paint brush, but there seems no reason why this should be neglected if the now well-known device for applying paint with a spray formed by compressed air, flowing through a suitable nozzle, is used. There is no doubt the thorough protection of metal under-framing by liberal use of paint well maintained is an important matter and too often neglected in American railroad practice. E. M. H.

Mr. W. B. Greenlee, in the *American Geologist*, estimates that the volume of water absorbed in the earth's crust to a depth of one mile, and over the entire land area of the globe, is 8,498,000 cubic miles.



Universal Construction Company's Steel Car Loaded With 40 Tons of Structural Steel.

A Heavily Loaded Flat Car.

On Sept. 22, 1896, on train No. 583, of he Chicago & Northwestern Railway, leaving Chicago at 8:45 p. m., there was taken to St. Paul car No. 201, built by the Universal Construction Company entirely of steel and loaded with 80,120 pounds of structural steel for the Northern Pacific Office Building, or which the Universal Construction Company has the contract. The accompanying cut, from a photograph taken at St. Paul, shows the size of the load and the method of securing it Careful inspection on arrival showed that the car and its freight had traveled in perfect safety and good order, and as the train referred to is a fast merchandise train and arrived at 2 a. m. on the 24th, showing that only 27½ hours were taken in transit, it is evident that this large and unique load did not in any way interfere with the usual rapid movement of this train. It speaks well for the construction of the car and trucks and the disposition of the 40 tons of material placed thereon.

The Universal Construction Company is continuing its experiments and its development of the metal car. It is just completing the construction of a modified form of flat car built on the Pennock plan, but somewhat simplified. It is also operating gondola cars in the coal business, carrying from 68,000 to 75,000 pounds at a trip, while its ore cars (one of which was exhibited at Saratoga), are carrying from 78,000 to 89,000 pounds at a trip. No weakness or defect has developed up to the present time in any of these cars, and the company is so well pleased with the result of its experiments, that it is bringing out further designs for refrigerator, stock and hopper cars. It has recently received inquiries from South America for equipment built on these lines.

The Cleveland, Cincinnati, Chicago & St. Louis Railway Company has abandoned the use of dummy couplers for hanging up air hose on its freight cars, and these cars will be accepted in interchange without the dummy couplings. Bills for repairs or replacement of same will not be accepted.

Water-Tube Boilers on French War Ships.

A Paris correspondent of the *Steamship*, writing on the suject of water-tuoe ooi.ers in the French Navy, says: "The question of the tubu.ar boilers, which Mr. Allan repeatedly raised in the House of Commons last session has sprung up here in consequence of the partial disablement necessitating the detention of two ironclads at Brest These vessels, the *Bouvines* and the *Amiral-Trehouart*, orm part of the northern squadron. They put into Brest last week, on arriving from St. Malo, and an examination of their boilers revealed defects in a certain number of the tubes. The latter needed to be replaced 'to avoid accidents similar to those which recently occured on board the *Jaureguiberry*.' After Mr. Allan's unwearied denunciations of the Belleville turbular boiler—one of his grounds for attack being that it was a French invention practically untested—and after the reiterations from the Treasury bench that the tubular boiler adopted had, on the contrary, undergone the most convincing tests, that it offered enormous advantages in respect to the time demanded for getting up steam, etc., and that the British Navy could not afford to be in arrears, it seems strange to find a French naval critic assailing the tubular boiler, and urging a return to the cylindrical boiler. Another interviewed person on the same side severely blames the Ministry for the Marine for fitting new war vessels, such as the *Chateaurenault*, the *Guichan* and the *d'Estrees*, with the tubular, or, as they are termed here, multitubular boilers. He quotes the example of the Italian Marine Department, which, as the result of the catastrophe on board the *Jaureguiberry*, at once substituted the cylindrical boiler defended by Mr. Allan for the tubular variety fitted to the cruiser *Varesa*, then in course of construction. The breakdown of the *Amival-Trehouart* was pronounced at Brest to be due to deposits inseparable from the system of the water-tube boilers. Three types of these boilers exist at present in the French Navy, and as it happens, they are placed upon three cruisers of an identical class—the *Chasseloup-Laubat*, the *Friant* and the *Bugeaud*. The *Belleville* may or may not resemble either of the types in question, but those who have criticised its adoption for British war vessels may be interested to learn that a strong cry has been raised on this side of the Channel for a further series of tests, and for the return to the cylindrical boiler at any rate until the superior character of the water tube boilers has been placed beyond all doubt by a perfection of the system.

Small Plant for Handling Coal and Ashes for Locomotives. Cleveland, Cincinnati, Chicago & St. Louis Railway.

Some months ago we described the plant for handling coal and ashes for the locomotives of the Cleveland, Cincinnati, Chicago & St. Louis Railway at Wabash, Ind. That plant is completely equipped with conveyors and manual labor is reduced to a minimum. But it is not always possible to put up such a plant, a case in point being the terminals of this same road at Louisville, where there is not room near the roundhouse for a regular coal chute, with conveyors.

ash pit, served with a crane, and further away from the roundhouse is a second crane on the coaling platform. The cranes are shown in Fig. 2, and in Fig. 3 is shown one of the ash cars placed in the ash pit.

The cranes are of the pillar type, and are worked by compressed air, and have a capacity of 3,000 pounds. The cylinder is 12 inches in diameter, and has a 9-foot stroke. Its piston carries a sheave at its outer end and a ¾-inch wire rope with one end secured at a fixed point passes around this sheave and over the one at the end of the crane. The load thus moves twice as fast and twice as far as the piston of the air cylinder. The other

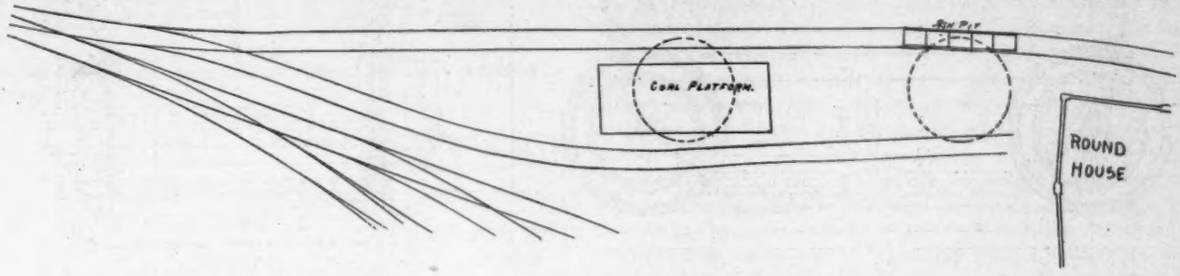


Fig. 1.—Plan of Coaling Tracks at Louisville.

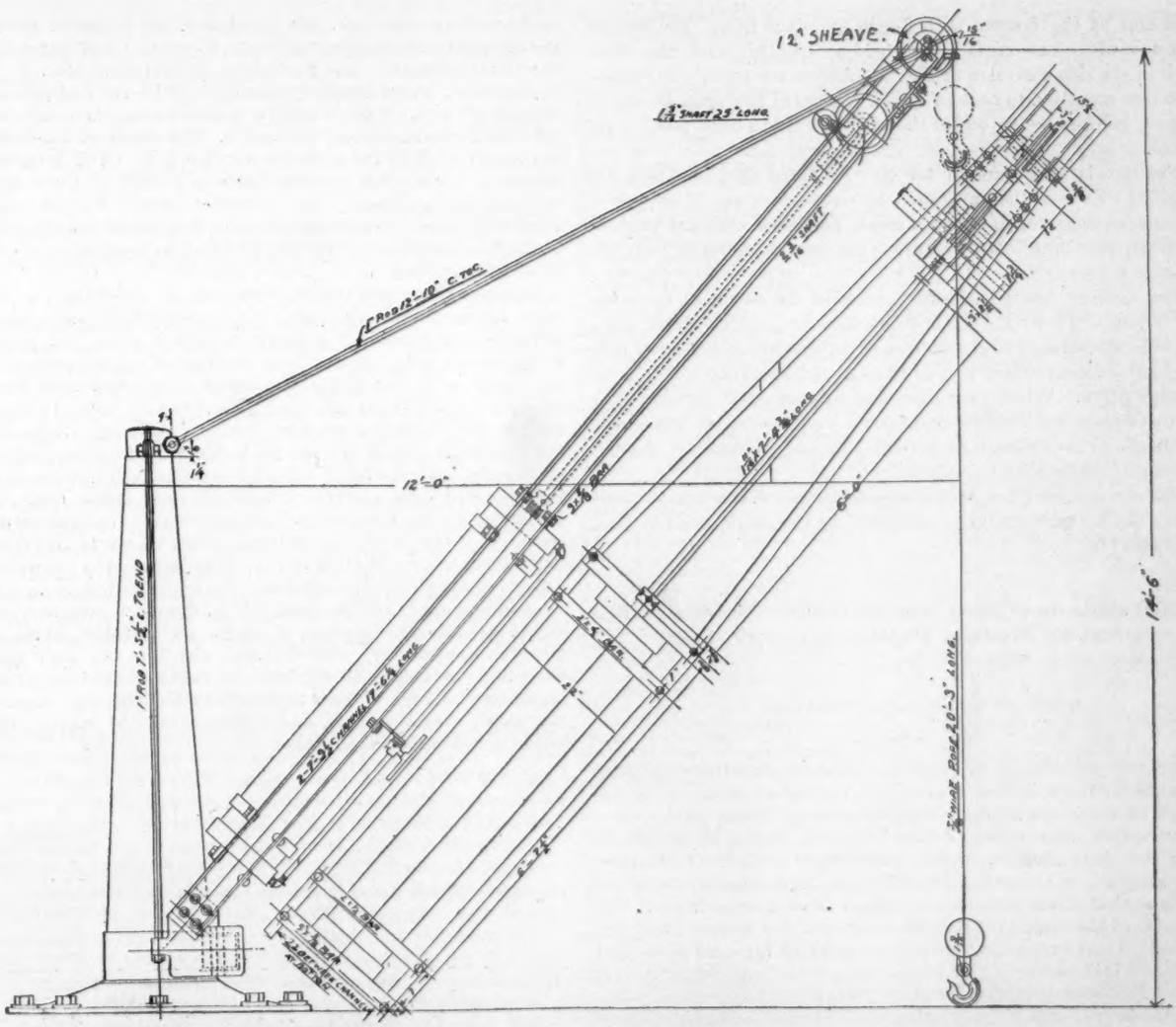


Fig. 2.—Pneumatic Crane for Handling Coal and Ashes at Louisville—C., C., C. & St. L. Ry.

At this point the problem of reducing the expense of handling coal and ashes has been solved in a way which will be readily understood from the accompanying engravings. Fig. 1 shows the arrangement of tracks at the coaling station. The upper track is the in-going track to the roundhouse. In this track is located an

details of the cranes will be readily understood from the drawing.

In the bottom of the ash pit there is a track of 30 inches gage, on which travel cars such as shown in Fig. 3. The bodies of these are made of $\frac{3}{16}$-inch plate, put together at the corners with 1½-inch angle iron, and stiffened at the top edge with 1½ inch by ¼-inch

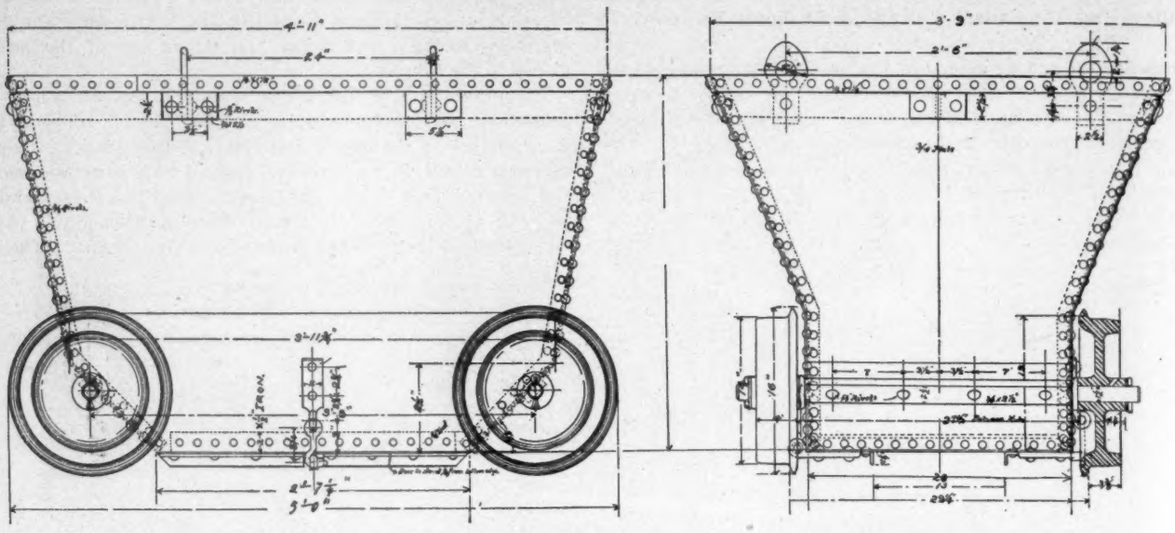


Fig. 3.—Car for Ash Pit at Louisville.—C., C., C. & St. L. Ry.

iron and at the bottom with 2-inch by ¼-inch iron. The bottom is a door hinged at one side, and held at the other with the hook seen in the side elevation of Fig. 3. Across the top of the box are two iron crossties, to each of which is secured two eyes, by which the car is lifted bodily out of the pit when it has been filled with ashes.

The pit is long enough for five of these cars, and they are handled by one of the air cranes, by which they are lifted out of the pit, swung over to the next track, and their contents emptied through the drop bottoms into a car kept standing on the coal-storage track.

The coaling operations are conducted by means of the other air crane. There are 12 coal buckets on the platform, each capable of holding about one ton, and these are so arranged that they can be conveniently filled from a car standing on the coal-storage track. When an engine is to be coaled the contents of as many of these buckets as necessary are delivered on the tender by means of the crane. At present between 15 and 20 engines are coaled daily with this plant.

The arrangement has proved so satisfactory for a small plant that a similar outfit is being installed by the same road at East St. Louis, Ill.

Experiments on a Steam Engine at Liege University, Belgium, by Professor Dwelshauvers-Dery, 1896.

NOTES BY MR. BRYAN DONKIN, M. I. C. E.

For the last few years Professor Dwelshauvers-Dery has been making, with his students, some interesting experiments on his single cylinder horizontal surface-condensing steam engine, provided with a brake pulley, cooled by water. Steam is introduced into the three jackets, barrel, and covers, or not, at pleasure. Superheated or saturated steam is used. All measurements are made so that a heat balance is obtained in each experiment. The cylinder of the engine is 1 foot diameter, and the stroke 1 foot 11⅝ inches. These experiments have been going on for some years, and it may be interesting to give a brief summary of some of the results which Professor Dwelshauvers-Dery has arrived at.

Experiments with a brake pulley to obtain the mechanical equivalent of heat.—The professor made several very exact experiments to obtain the mechanical equivalent of heat due to the rise in temperature of a certain quantity of water cooling the hollow brake. This brake absorbed a certain quantity of power, and so much heat was put into the pulley. By a water cooling arrangement this heat was continuously taken away by the water, cold water going in and hot water running out. The quantity of such water was very accurately measured by means of a circular orifice, previously gaged by tanks with extreme care. He thus had all the means of ascertaining the power absorbed by the brake, the quantity of water, and its rise in temperature. The mechanical equivalent of heat, as found by Rowland, is now generally admitted to be 778 foot-pounds per Fahrenheit unit. This, in metric measurement, is equivalent to 426·83 kilogramme-meters per calorie. The mean of six-brake experiments made by the professor works out at 427·22 kilogramme-meters, or higher than the first figure by a tenth of 1 per cent.—a very satisfactory result. The mechanical efficiency of the engine in these experiments was 88 per cent., or, in other words, 12 per cent. of the total indicated power was absorbed by working all the parts of the engine itself.

Experiments relating to the advantage of draining the steam-chest, using steam jackets, and also superheated steam.—To determine the consumption of steam in pounds of water per indicated horse power hour, the professor calculated the experimental results as follows: He took the number of thermal units actually used by the engine per indicated horse power per hour. Then taking the number of thermal units per pound of steam as 1,179, he obtains the number of pounds of water per indicated horse power hour. This is the right method when it is desired to compare the pounds of water per indicated horse power hour from different steam engines, and particularly when some engines use superheated and some saturated steam; or if they work with different steam pressures. With regard to draining the steam chest or the steam jackets, the hot water can either be sent down the drains to waste or the heat in them utilized by being pumped into the boiler. It is, therefore, necessary to calculate separately the pounds of water per indicated horse power hour in these two very different cases, and this has been done in the following tables. In this way the economy has been obtained separately for each of these three great questions, viz., draining of the chest, steam jackets, and superheating the steam. Engine working condensing in all cases:

TABLE A.

No.	Kind of Steam.	Draining the hot water from steam chest or not.	Steam in three jackets, barrel, and two covers or not.	Consumption of steam in lbs. per I. H. P. hour.	
				The hot drained water being wasted.	The hot water sent to boiler.
1..	Saturated steam.	Not draining.	No steam in jackets.	32.64	0 00
2..	do.	Draining.	ditto	30.43	29.61
3..	do.	Not draining.	Steam in jackets.	24.57	24.00
4..	do.	Draining.	ditto	21.81	21.10
5..	Superheated steam (72 deg. F. of superheat)	Not draining.	No steam in jackets.	25.56	0.00
6..	do.	Draining.	ditto	27.06	26 92
7..	do.	Not draining.	Steam in jackets.	19.47	19.16
8..	do.	Draining.	ditto	19 83	19.42

Steam pressure, 80 lb. Cut-off, one-tenth. Working, condensing.

TABLE B.

The economy due to the draining of the steam chest only is obtained by comparing

	In the case of	The economy is part of hot water	
		Being wasted.	Being utilized.
		Per cent.	Per cent.
2 and 1	Saturated steam and no steam in jackets....	6.87	9.29
4 and 3	" " steam in jackets.....	11.27	12.68
6 and 5	Superheated steam and no steam in jackets.	— 5.87	— 5.33
8 and 7	" " steam in jackets...	— 1.82	— 1.34

The sign minus (—) indicates a loss instead of a gain.

TABLE C.

Economy due to using steam in the three jackets is obtained by comparing

	In the case of	Percentage of economy, is as follows, the drained water being	
		Lost	Utilized.
		Per cen .	Per cent.
3 and 1	Saturated steam and not draining the chest.	24.72	26.47
4 and 2	" " " draining the chest.....	28.27	28.73
7 and 5	Superheated steam and not draining the chest.....	23.80	25.02
8 and 6	Superheated steam and draining the chest..	26.72	27.86

TABLE D.

The economy due to superheating only (amount of superheat 7 deg. Fahr.) is obtained by comparing

	In the case of	Percentage of economy the drained hot water being	
		Lost	Utilized.
		Per cent.	Per cent.
5 and 1	No steam in jackets and not draining chest.	21.70	0.00
6 and 2	" " " draining the chest.	10.98	9.07
7 and 3	Steam in jackets and not draining the chest.	20.75	20.16
8 and 4	" " " draining chest.....	8.06	7.97

The best experiment in this single-cylinder engine in the consumption of steam was with superheated steam of 72 degrees Fahrenheit (of superheat), both in the cylinders and jackets, and not draining the cheet, which resulted in 19.45 pounds of steam per indicated horse power hour. The least economical was with saturated steam without jackets and without drainage, when the engine used 32.6 pound per indicated horse-power hour. Comparing these two results, there is an advantage of 41 per cent. in favor of the combined effect of using superheated steam both in the jackets and inside cylinder, as compared with no jacket and no draining, and saturated steam. It is well to add that this steam engine was not made for greatest economy, but for educating the University students in all the practical details of making engine tests, taking diagrams, and accurately recording results—an education which has had great success at Liege, and is very popular with the young men.—*The Engineer.*

The New Torpedo Boats.

On October 6th the contracts for the new torpedo boats for the U. S. Navy were awarded as follows: To the Bath Iron Works, Maine, two 30-knot boats of 230 tons displacement for $235,000 each; these boats will be 180 feet long, 18¼ feet beam, 11½ feet deep, 5 feet 3½ inches draft. To the Union Iron Works, one 30-knot boat of 273 tons displacement for $227,500; it will be 210 feet long, 20⅜ feet beam, 14⅛ feet deep, 6 feet draft. To Wolff & Zwicken, Seattle, two 22½-knot boats of 117 tons displacement for $75,100 each; these will be 146 feet long, 15⅛ feet beam, 10¼ feet deep, 5⅛ feet draft. To the Herreshoff Manufacturing Company one 22½-knot boat and two 20-knot boats: the 20-knot boats will be of 46½ tons displacement and will cost $37,500 each; they will be 100 feet long, 12½ feet beam, 3½ feet draft and 850 horse-power. To Columbia Iron Works, Baltimore, and the Charles Hillman & Co., Philadelphia, one 20-knot boat each for $49,000 and $48,500 respectively. These two boats will be alike and have 65 tons displacement, 101½ feet long, 12½ feet beam, 4½ feet draft and 850 horse power. It is reported that these 20 knot boats, so much slower and smaller than craft of this character now built by other nations, are of such dimensions that they can be sent through the canals to the great lakes if occasion should require it.

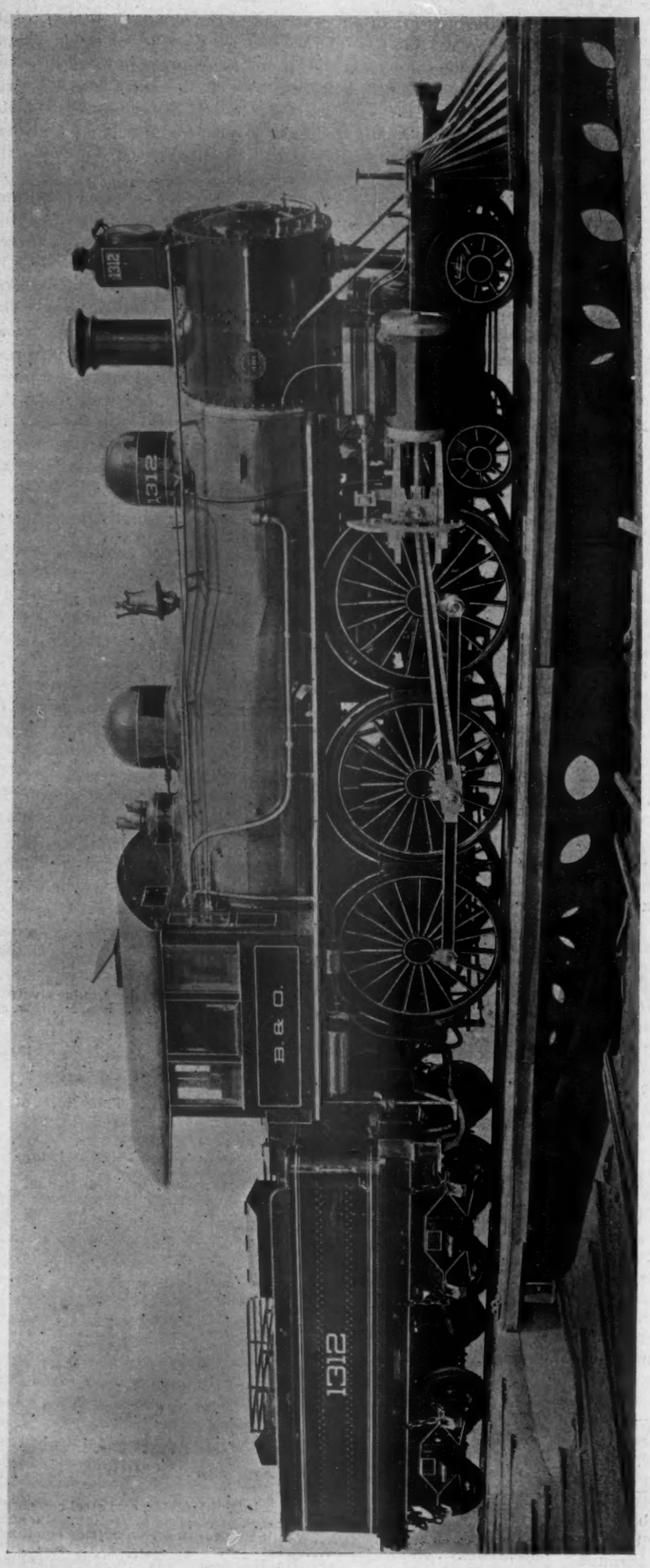
New Equipment on the Baltimore & Ohio Railroad.

On the occasion of a recent visit to the Mount Clare shops of the Baltimore & Ohio Railroad we had the pleasure of seeing one or more engines of several classes embraced in the order of 75 given out some months ago. Most of these engines have been delivered now, and Mr. Harvey Middleton, General Superintendent of Motive Power, has kindly furnished us with the principal dimensions of several classes of them and with photographs from which the accompanying engravings were made.

The new passenger engines are of the ten-wheeled type, and are of two classes, differing from each other chiefly in the diameter of the drivers and the size of the cylinders. The larger engines have cylinders 21 by 26 inches, and driving wheels 78 inches in diameter. Unless we are mistaken these are the largest drivers ever used in this country on ten-wheeled engines. The cylinders and boilers are large, and give these engines great power. They are intended for service on the heavy express trains between Philadelphia and Washington. There are a number of interesting details in their construction, and we hope in the near future to illustrate these details from working drawings. In the meantime we present an engraving from a photograph which gives an idea of their handsome appearance. The leading dimensions of the two classes of engines are as follows:

21-INCH BY 26-INCH AND 20-INCH BY 26-INCH, TEN-WHEELED PASSENGER ENGINES BUILT FOR THE B & O. R. R. BY THE BALDWIN LOCOMOTIVE WORKS.

Type and number ordered....Ten wheel	6	4
Simple or compound	Single Expansion	
Total wheel base	24 ft. 6 in.	24 ft. 6 in.
Rigid wheel base	13 ft. 8 in.	13 ft. 8 in.
Total wheel base of engine and tender..	51 ft. 8¼ in.	51 ft. 8¼ in.
Total length of engine and tender	61 ft. 9 in.	61 ft. 9 in.
Diameter of cylinders	21 in.	20 in.
Stroke of piston	26 in.	26 i .
Diameter of piston rods	3½ in.	3½ in.
Size of steam ports	19 in. by 1⅝ in.	19 in. by 1⅝ in.
Size of exhaust ports	19 in. by 2¾ in.	19 in. by 2¾ in.
Greatest travel of slide valves	6 in.	6 in.
Outside lap of slide valves	1 in.	1 in.
Lead of slide valves in full stroke	3/16 in.	3/32 in.
Diameter of driving wheels, outside.	78 in.	68 in.
Kind of truck wheels	Wrought center	Wrought center
Diameter of truck wheels	33 in.	30 in.
Size of driving axle journals	8 in. by 10 in.	8 in. by 10 in.
Size of truck axle journals	5 in. by 10 in.	5 in. by 10 in.
Size of main crank pin journals	6 in. by 6 in.	6 in. by 6 in.
Description of boiler	Wag. top	Wag. top
Diampter of boiler at smallest ring	60 in.	60 in.
Material of boiler	Steel	Steel
Thickness of plates in boiler barrel	5/16 in.	5/16 in.
Thickness of plates in firebox shell	5/16 in.	5/16 in.
Thickness of plates in sides, back end and crown of firebox	3/8 in. 7/16 in.	3/8 in. 7/16 in.
Thickness of plates in front and back tube sheets	½ in.	½ in.
Kind of horizontal seams	Butt	Butt
Kind of circumferential seams	Double riveted	Double riveted
Material of tubes	Iron No. 12 w. g.	Iron No. 12 w. g.
Number of tubes	231	231
Outside diameter of tubes	2¼ in.	2¼ in.
Length of tubes over tube sheets	14 ft. 7½ in.	14 ft. 7½ in.
Inside length of firebox	120⅝ in.	120⅝ in.
Inside width of firebox	41 in.	41 in.
Depth of firebox from crown sheet to bottom of mud ring	F. 73½ in. B. 61.	F. 73½ in. B. 61
Water spaces, sides and back	3	3
Water spaces, front	4	4
Crown plate stayed with (one 1-in n front, bolts 1¼ diameter)	Radial stays	Radial stays
Diameter of dome	31½	31½
Height of dome (from top of rail)	14 ft. 9 in.	14 ft. 4 in.
Steam pressure, pounds	190	190
Kind of grate	Rocking	Rocking
Grate surface, square feet	34.27	34.27
Heating surface of firebox, square feet..	215 2	215.2
Heating surface of tubes, square feet....	1,978.52	1,978.52
Total heating surface, square feet	2,193 72	2,193.72
Height from top of rail to top of smoke-stack	15.0 in.	14.7 in.
Tires, kind and make (Standard)	Steel	Steel
Tender.		
Wheels	36	33
Axles	Steel	Steel
Size of axle journal	4¼ by 8	4¼ by 8
Water capacity of tank	3,500	3,500
Frames, wood or metal	Wood	Wood
Breakbeams, kind and make (Nat'l hollow)	2½ in.	2½ in.
Break heads and shoes, kind and make	Mall. head	Cast iron shoe
Details of Equipment.		
Guides and crossheads, type and metal	Two bar type iron (C. H.) guides, cast steel crosshead	
Connecting rods	Steel, parall l rods I section, solid ends	
Brakes	Westinghouse-American outside equalized	
Lubricators	Nathan S. F.	Nathan S. F.
Injectors	No. 10 Metropolitan	No. 10 Metropolitan
Valves	Three Crosby Muffled, 2½ in.	



21-Inch by 26-Inch Ten-Wheeled Passenger Engine—Baltimore & Ohio Railroad.

Built by the BALDWIN LOCOMOTIVE WORKS.

MR. HARVEY MIDDLETON, Superintendent of Motive Power.

Gages .....Two Crosby thermostatic
Springs .....B. L. W.
Headlights..... 18 in. sq.
Special devices. Compressed-air signal; Leach tandem; Gold Steam Heating device; Gould coupler.

In the construction of all of these engines there are a number of details of interest. One feature that should not be overlooked is the manner in which the frames are braced. In engines whose boilers project through, or nearly through, the cab, the foot-plate is conspicuous by its absence, or is at best a comparatively short affair. The long foot-plate undoubtedly does much to prevent working of the frames, particularly in a longitudinal direction, and yet when the long foot-plate is omitted nothing takes its place in bracing the frames against the tendency to a racking motion of this kind. The cylinder saddles alone must resist the strain, and the mechanical department is of the opinion that herein is a partial explantion of the trouble with loose cylinder fastenings and fractured saddles. To remedy these troubles the new engines, and also such engines as go through the shops for heavy repairs, are provided with wide and heavy plates extending across the frames at some convenient point. In the new consolidation engines they are placed on top of the frames immediately back of the cylinder saddle and are 20 inches wide in the middle and 24 inches wide at the ends. They lip down over the frame inside and outside and are solidly bolted into position. In the case of some 10-wheeled engines being repaired in the shops the plates were placed across the frames at a point about midway between the cylinder saddle and firebox. Their exact location is of course a matter of convenience and clearance of other parts of the engine. Some of the new consolidations also have several heavy ribs on the outside of the saddles.

The guide-blocks on the consolidations each have three bolts, or one more than usual, making a very secure fastening. The parallel rods all have solid ends except the front ends of the front rods, where straps are used, as the cross-head would have interfered in the removal of a solid end rod.

Considerable care has been exercised in all the engines to have the cab fixtures convenient to the men, and the interiors of the cabs look very comfortable. The fireman has a steam gage for his own use, the face of which is exposed through an opening in the back of the cab. The fronts of the cabs are cast iron, from the boiler to the doors and windows.

The tanks have large filling-holes, that avoid the necessity of stopping exactly opposite a water station. The opening is 4 feet long and 1 foot wide, and is placed the long way across the tank. The water-spout can thus be at considerable of an angle and yet deliver water into the tank. There are a number of other features of the 10-wheeled engines, to which we will call attention when we publish the detail drawings.

On most roads the problem of counterbalancing engines refuses to remain settled, and if the mechanical department grapples with it, and, as they think, vanquish it, the obsequies are hardly over before its ghost appears. No matter how good the rules adopted and the precautions exercised, it seems as if some vio-

lations of the practice of the road will remain to be discovered from time to time. On this road they recently took the wheels out from under some modern passenger engines and found the axle journals smooth and apparently in good condition, but eccentric with the remainder of the axle by as much as three-sixteenths of an inch in the worst cases. The tires were also in bad shape, and upon examining the back pair of drivers they found that the builders had balanced all the revolving, and from 12 to 47 pounds more than *all* the reciprocating, weights for those wheels. Unfortunately the main wheels had been removed from their axles by the time this discovery was made, and it is not known whether or not they were short of balance. But this is an illustration of the necessity of extreme vigilance in following out the details of counterbalancing, if correct practice is to be obtained.

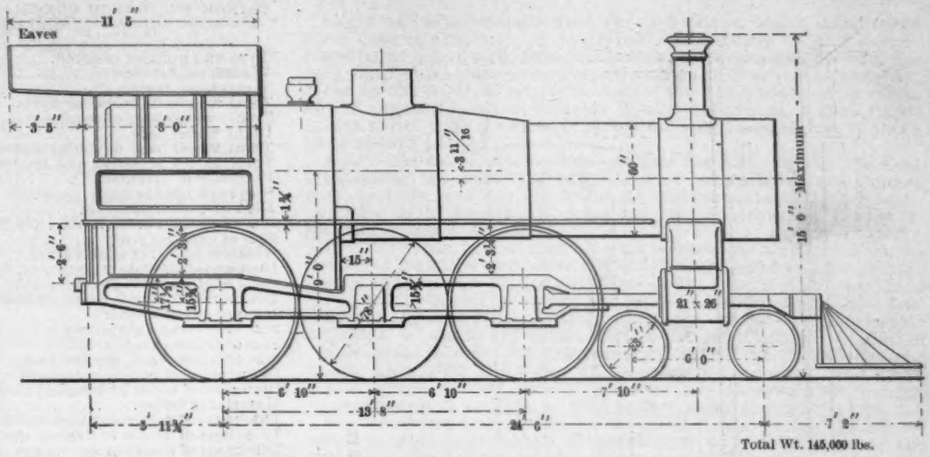
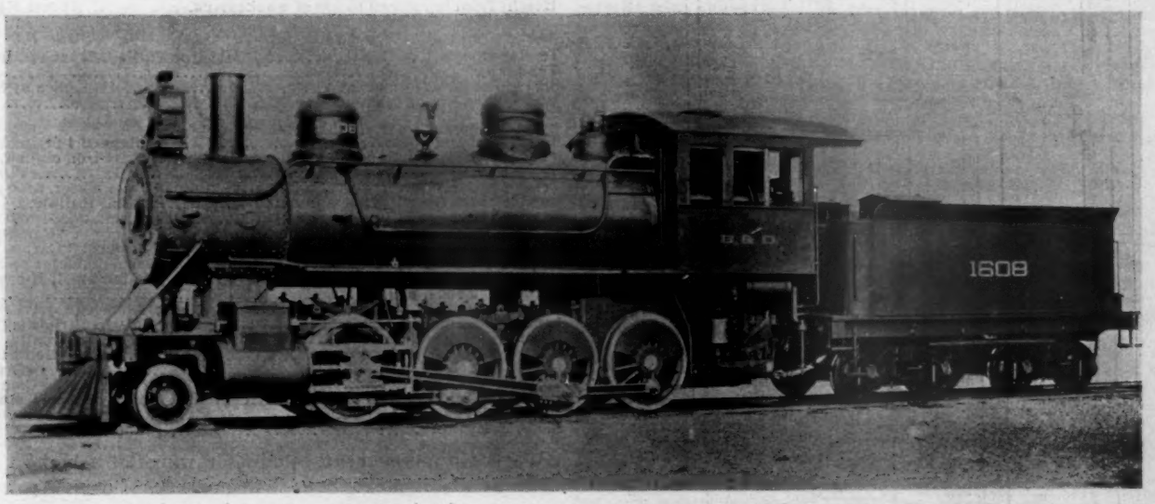


Diagram of 21 by 26-inch Ten-Wheeled Engine—Baltimore & Ohio Railroad.

The consolidation engines built for the company are of two sizes. The larger of these is shown in Fig 1, and has cylinders 22 inches by 28 inches. The smaller engines have cylinders 21 inches by 26, and resemble the larger engines so much in general appearance that we have omitted the photograph of the smaller. The smaller engines do not have the second small steam dome seen in Fig. 1, otherwise they look about the same except for the matter of size. Both classes are powerful engines, as will be seen from the following dimensions of engines built by the Cooke and Richmond companies:



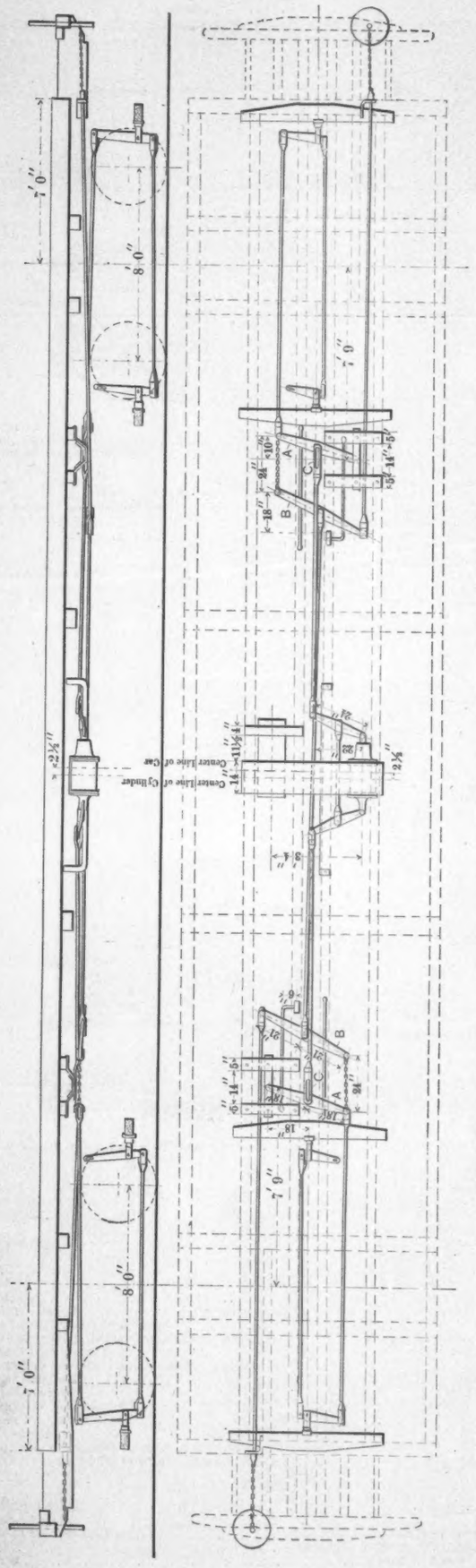
22 by 28-inch Condsolidation Engine for Baltimore & Ohio Railroad—Built by the Cooke Locomotive and Machine Company.

22-INCH BY 28-INCH CONSOLIDATION ENGINES BUILT FOR B. & O. R.R. BY COOKE LOCOMOTIVE AND MACHINE CO.

Type and number ordered	consolidation, 10
Total weight in working order	166,000 pounds
Total wheel base	23 feet 2 inches
Rigid wheel base	15 feet
Total wheel base of engine and tender	51 feet 7 inches
Total length of engine and tender over all	61 feet 3 inches
Diameter of cylinders	22 inches
Stroke of piston	28 inches
Size of steam ports	20 inches by 1⅝ inches
Size of exhaust ports	20 inches by 3¼ inches
Greatest travel of slide valves	6 inches
Outside lap of slide valves	1⅛ inch
Lead of slide valves in full stroke	1/16 inch
Diameter of driving-wheels, outside	54 inches
Kind of truck wheels	30-inch steel-tired, wrought-iron spoke center
Size of driving-axle journals	8½ inches by 10½ inches
Size of truck-axle journals	5 inches by 8½ inches
Size of main crank pin journals, main rod	6¼ inches by 6 inches
" " " parallel rod	6½ by 5½ inches
Description of boiler	wagon top
Diameter of boiler at smallest ring	64 inches
Material of boiler	Park Bros., steel
Thickness of plates in boiler barrel	7/16 inches and 5/8 inches
Thickness of plates in firebox shell	5/8 inches
Thickness of plates in sides, back and crown of firebox	3/8 and 23/32 inches
Thickness of plates in front and back tube sheets	½ inch
Kind of horizontal seam	Butt with double welt
Kind of circumferential seams	double riveted
Material of tubes	Iron
Number of tubes	248
Outside diameter of tubes	2¼ inches
Length of tubes over tube sheets	14 feet 9 inches
Inside length of firebox	115 inches
Inside width of firebox	41 inches
Depth of firebox from crown to bottom of ring	67 1/16 to 69 7/16 inches
Water spaces, sides and back	3 inches
Water spaces, front	4 inches
Crown plated stayed with	crown bars
Diamater of dome inside	30 inches
Steam pressure, pounds	180
Kind of grate	Rocking
Grate surface, square feet	37.75
Heating surface of firebox, square feet	182.5
Heating surface of tubes, square feet	2,155.0
Total heating surface, square feet	2,337.5
Height from top of rail to top of smokestack	14 feet 7 inches
Tires	Standard Steel Company's
Guides and crossheads	Guides steel, crossheads steel, alligator style
Connecting rods	Channeled bodies
Brakes	Westinghouse: American driver brakes
Lubricators	Nathan triple
Injectors	Monitor No. 10
Valves	Richardson balanced
Gages	8½ inch Crosby
Springs	Pickering
Headlight	Kelly, 18-inch, with B. & O. frame for numbers
Special devices	Coale 3-inch muffled safety valves

Tender.

Wheels	33-inch chilled
Axles	Steel
Size of axle journals	4¼ inches by 8 inches
Water capacity of tank, gallons	4,000
Frames, wood or metal	Wood
Brake beams	National hollow
Brake heads and shoes	Christie


1'0"
8'0"
1'0"
Center line of Cylinder
Center line of Car
2½"
2½"
A
B
C
10"
9½"
18"
5'-1½"-5"
5'-11½"-5"
14"-11½"-4"
22
23
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and the application of the air puts no strain on the brake-staffs, The levers *B B* come into service only when the hand-brakes are used. One end of each is connected to a brake-staff and the other ends are attached by chains to the levers *A A*. They are also connected to each other by a long "middle connection." The chains between *A* and *B* becomes slack when the air is applied, and if the hand-brakes alone are put on the slotted connections *C C* permit the levers *A A* to move without disturbing the air-brake piston. It will readily be seen that if a car is set out on a siding and brought to rest with the air brakes, the train men can set the hand brakes in addition, and leave the car with the assurance that when the air leakes off it will still be firmly held by the hand brakes.

Car Heating by Steam.*

BY MR. R. M. DIXON.

An inquiry among those having charge of equipment on cars shows that success of steam heating is almost universal, so few troubles occur. There seems to be but few instances on any road during entire seasons, and almost all trouble can be either traced to lack of steam circulation in the train pipe, or to insufficient attention to the drips or traps. Cars cut out of trains sometimes have pipes freeze, but this is always due to neglect in opening drainage valves.

Train pipes as used for all couplers should have their ends conform to the Master Car Builders' position for direction and location. It is well to bear in mind in placing them that the tendency of the ends of cars is downward, and as the couplers, if hanging uncoupled, will almost strike the switch tracks and crossings, the end of the train pipe should be placed above rather than below the standard position. The train pipe should drain from the point where the car supply is taken off to its ends. If it cannot be done and keep the train pipe below the floor sheathing, then a first-class plan is to run it between the car sills and above the sheathing. In such a place, covering but ⅝ inch thick will suffice; while if below the sheathing, covering 1 inch thick is advisable. The arrangement of the train pipe above the sheathing is standard on some roads, and it has much to recommend it.

Such train-pipe cocks should be used as are readily understood on sight. There is but little time to study out a system when a train is ready for service, and experience teaches that train-pipe cocks are the part of the equipment most difficult to understand. In service all train-pipe cocks but one, the rear one, are to be open, and in cold weather the rear one should be open enough to let just a little steam escape through it so as to maintain a circulation of steam throughout the train pipe, whether or not the rear cars are using steam.

The covering should be well applied to the train pipe; otherwise it will not stay on. Instances can be cited where the covering has remained in place but a short time, and more than one-half the train pipe become exposed and in condition to cause more condensation than all the radiating surface in the car.

As to the amount of direct steam-radiating surface in a car, experience has led to the use of two 2-inch standard iron pipes along each side. This is somewhat below what heating engineers would figure as necessary to keep the cars warm in zero weather; but as more has been found very excessive for moderate weather, a sort of compromise has resulted. The only way to satisfactorily warm cars by direct steam in all kinds of weather is to have appliances that will permit of varying the amount of radiating surface into which steam is supplied, and so approximate to a suitable heating surface to meet the conditions existing. Such a arrangement also permits of quickly heating cold cars, without overheating them when warm.

All valves and fittings placed inside of the cars should be heavy, and not liable to leak or have the bonnets come off when opening. The valves should have their use cast plainly on the handles.

For direct steam, an automatic trap for discharging the condensation is not necessary, nor desirable. The amount of condensation to be discharged after a car is warmed varies but little, and any increase or decrease of condensaaion is in the same direction as the change in steam pressure within the radiating pipes. Therefore, an orifice adjusted to take care of the condensation at any pressure will discharge a greater amount of condensation when there is a greater pressure to expel it.

*From a paper read before the New York Railroad Club, Oct. 15, 1896.

Angle valves are usually used for drip valves, and in many cases have been so arranged as to prevent their being entirely closed. Experience has taught that it is better not to so arrange them. A very simple and safe method of adjusting the drip valves properly, given by Mr. A. M. Waitt, is to touch the hand to the drip valve, and if the hand can be borne on it and it is warm, it is all right. If it is so hot that it burns, it is too far open; and if cold, it needs to be opened a little.

With hot-water circulating systems for distributing the heat throughout the cars, the regulation of the temperature is quite easy, and the heat can be carried to various parts of the car without the multiplication of drips for the condensation that is required for direct steam.

It is desirable, in conjunction with water-circulating systems, to use some kind of a device for discharging the condensation, which device shall be in a degree automatic. The rate of condensation is quite variable, and generally the drip is located under the car, where it cannot receive close attention. If not automatic and adjusted to discharge sufficiently while heating the circulating water and raising the temperature of the car, it will be too much open after the water is hot and the car warm, and much steam will be wasted, causing not only loss of steam, but damage to car floors and varnish, as well as annoyance around the cars.

The following set of rules for handling steam equipment may be found reliable, especially if supplemented by a description of the system in use, and modified as the system may require.

RULES FOR HANDLING STEAM-HEATING EQUIPMENT—MAKING UP TRAINS.

When a train is made up, all steam hose should be coupled, and all the cocks in the steam train pipe the whole length of the train should be opened.

When signal is given, steam should be turned on at the cab, not to exceed 65 pounds, and allowed to blow through the entire length of the steam train pipe.

After steam issues at the rear end of the train pipe, the rear cock of last car should be closed, and reducing valve in cab set to 40 pounds pressure. If more than eight cars are in the train, add 5 pounds for each additional car. In very cold weather the rear train-pipe cock should be left open enough to allow a little steam to pass and escape through the rear coupling.

REGULATION OF TEMPERATURE.

To heat cars, open steam inlet valves on each car; and when live steam appears at the drips, set each drip so that a little steam escapes with the water. If a trap be used, see that it is adjusted to allow a littie steam to escape with the water.

Frequently examine traps and drip valves to see that they are operating properly. They should be as hot as can be borne by the hand. If cooler, or cold, they should be opened a trifle; or if too hot, or steam is blowing, closed a little.

Never close steam inlet valves entirely without first opening drip valves or blow-off valve, and allow water to blow out before closing steam inlet valve.

When steam is required on this car again, open steam inlet valve, and afterwards close drip valves or blow-off valve.

CHANGING ENGINES.

When approaching stations where engines are to be changed, or terminals where cars are to be laid up, five minutes before arriving at such stations the rear train-pipe cock must be opened wide, and before coming to a stop at such stations the engineer must shut off steam at boiler valve. Do not use reducing valve for this purpose.

If engines are to be changed, trainmen must satisfy themselves that steam is shut off at engine before uncoupling cars.

In freezing weather, if cars are to be laid up, or stand thirty minutes after engine is uncoupled, the hose throughout the train must be uncoupled, and all drip valves or blow-off valves opened.

The greatest expense of maintenance of steam equipment is the renewal of the coupling hose. The following set of specifications and rules for testing are reasonable, and have been found to give good results. At least one per cent. of each lot of steam hose should be tested:

Samples selected at random from each invoice must deflect 5 inches for each 24-inch length for a pull of not more than any shown in the following table:

Steam at 45 pounds to 60 poundspressure to be on hose 10 hours and off 14 hours of each day.

Maximum allowable pull to deflect 5 inches.

	Before test.		During test of two weeks.	
	Cold.	Hot.	Cold.	Hot.
1¼-inch hose..	45 ounces.	35 ounces.	55 ounces.	45 ounces.
1½-inch hose..	60 ounces.	50 ounces.	75 ounces.	70 ounces.

After the test the tube must be in good condition, and the hose must not have increased in outside diameter more than 10 per cent.

All hose to be smooth, uniform and well finished.

Governor Morton of New York has decided not to approve of the report of the committee recommending the adoption of the Savage gun for the State militia. He exonerates the committee from the charges brought against it by disappointed competitors and states that the report of the committee appears to be unbiased. His decision is based on the ground that the expenditure for the guns ($800,000) is not warranted, as the United States government is contemplating arming all the militia with Springfield rifles. The Governor has also learned that there is some doubt as to a high-grade magazine rifle being necessary for such a body of troops as the State militia.

(Established 1832.)

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A noteworthy event in the progress of the horseless carriage is announced in dispatches from London. A company operating nearly 1,000 omnibuses in that city is going, it is said, to put into service in November 100 new motor "buses," in which electricity will take the place of horses. The dispatch says that 300 more motor omnibuses will go into service in January. If this is true—we must admit we doubt it—and the selection of the style of driving machinery is wisely made, the experience gained should go far toward deciding the immediate future of the horseless carriage. If motor omnibuses can be successfully operated in the crowded streets of London, others will have faith to push the development of this type of vehicle.

The labor involved in the preservation of information contained in technical journals is serious enough to make every one who systematically files such data eager to adopt shorter and easier methods. The most novel method we have heard of is that of photographing articles of value and filing the photos. All that is necessary is to have a small camera on your desk, and when an article is to be copied the camera is turned on it, you press the button and 'tis done. This sounds well but unfortunately that is not the end. Visions of a dark room float before us, and we see an individual bending over a developing tray and occasionally cussing at a plate on which a picture will not come, or on which it is so indistinct that he can't tell whether it is that article from the AMERICAN ENGINEER which he wished particularly to save, or a page from "Trilby." This amateur photographer and veteran collector of engineering notes after spending the whole evening in the dark room finally places the good plates in a drying rack and retires to rest in the small hours of the morning. Next day he forgets about his plates and when he does think to examine them he finds most of them were not washed properly and have been ruined by "sweating" The inventory of the first 30 plates exposed reads about like this: Plates with no picture at all, 6; negatives under-developed and illegible, 11; negatives out of focus and useless, 5; plates spoiled in developing, fixing and washing, 4; good plates, 4. After studying this inventory and noting that the four good plates are the least important of the lot, our amateur photographer probably decides that running a camera is not as easy as it looks and he will return to the good old way of filing his notes.

The report that Mr. Yarrow, the well-known shipbuilder on the Thames, England, is contemplating the transfer of his business to the continent, has caused no little stir in the industrial circles of Great Britain. It appears that the labor problem has been the predominant factor in raising the question of removal. *Engineering*, in a leading editorial on the subject, says some things which workmen the world over should take to heart. We quote a few words as follows: "Workingmen are not less interested in the state of affairs revealed by Mr. Yarrow's action than are employers. How are they to protect themselves against the competition of low wages? We do not think that the remedy lies in the reduction of the rate of pay, or even in an increase of the hours of labor. What is wanted is a full recognition of the fact that a good day's work is the complement of a good day's pay. . . . If the leakage that takes place in most works could be avoided, half our commercial difficulties would disappear at once. Trade union delegates are fond of talking about the partnership of capital and labor, and therein lies the kernel of the whole matter. If the workmen would realize that out of every penny lost to the firm, three farthings comes out of their pockets, and would act on that fact, half the danger of foreign competition would be at an end. Idleness, drunkenness, inefficiency, insubordination, and the like have all to be paid for out of the 'wage fund,' and although the money comes through the master's hands, yet in the long run it is paid by the workmen." These are facts which employes should bear in mind constantly, particularly those employed in a country like this, where wages are higher than in other lands. High wages and low cost of production can only go hand in hand when the use of labor-saving machinery is supplemented by good, conscientious work on the

part of the men. Dissipation that begins Saturday night and ends Monday noon or Tuesday morning, not only causes a man's wages to rapidly disappear, but it entails loss upon his employer because of the half-filled shop on Monday, the delayed work, and the inefficiency of the man whose mental and physical powers are weakened by such a course. Equally real is the loss arising from indolence in working hours, from bad work, or the waste of supplies, etc. These losses may for a time only operate to increase the cost of the work done, but ultimately they will reduce the wages of the employee, thus placing the loss where it belongs. High wages can be maintained only by a partnership between the employer and the employee, in which the former furnishes the best of facilities in the way of plant, labor-saving devices and competent superintendence, and the employee contributes the best work possible, contributes it regularly, and adopts peaceable methods for settling disagreements between himself and his employer.

OUR CRIPPLED NAVY—WEAKNESS OF ITS PRESENT ORGANIZATION.

The growth of our new navy, as evidenced in its powerful battleships and swift cruisers, is a source of pride to the American people, and it is with much satisfaction that they contemplate the engineering skill exhibited in the design of these vessels. Unquestionably, there is good reason for much of this pride, for not only do the vessels rival those of the most advanced nations in machinery, guns and armor, and in all the essentials of efficient fighting machines, but they have been created by a nation that only a decade ago had no navy worthy of the name and whose magnificent merchant marine of 50 years previous had dwindled to insignificance.

So remarkable has been the growth of our navy that the fleet which is now the pride of the American people is the wonder of other nations. But little more than a decade of modern naval construction has sufficed to bring into prominence the work of American naval engineers and American builders and manufacturers of naval structures and materials.

Some of the greatest advances in the construction of armor are the work of American engineers and manufacturers; the ordnance on our vessels is as good as that possessed by any other nation; the engines that propel them are recognized to be of such excellence that a fleet engineer in the English navy, after saying that his nation had little or nothing to learn from foreign nations about marine machinery, added, "not even from the United States"; the boiler power given these vessels is so abundant that we hear of none of the vexatious failures common in some of the best navies, and the advantage which American men-of-war possess in their ability to run at full speed over long distances without distress to boilers or engines is recognized abroad; our battleships, while not the largest, are noted for the heavy armor and ordnance carried on their displacements; the cruisers *Columbia* and *Minneapolis* are the swiftest war vessels of their type afloat; and in the new armored cruiser *Brooklyn* the United States government possesses another vessel that leads its type in speed. Such achievements as these in a period of little more than ten years, are rightly viewed with pride, although only men like our readers, who have a technical knowledge of engineering and industrial enterprises, can fully realize the extent of the progress made.

It is so pleasant to view this side of our naval growth that it is all the more disappointing to turn our attention to another and more important part of the navy, one which is less creditable to us as a nation. We refer to its personnel. The material side of our navy, represented by its ships and their equipment, is a bright picture, but the personnel presents a picture that though brilliant and attractive in many respects is, nevertheless, sadly stained and discolored. The best interests of the navy require that this picture be studied with care. All that is grand in the modern war vessel has been given general publicity, but exceeding care has been taken that outsiders should not know how inefficient our navy would prove in time of war through the weakness of its organization. The taxpayer is given full opportunity to ascertain the qualities of the ships in which millions are invested, but the fact that these millions of investment are endangered in times of peace and virtually rendered impotent in war by an organization that reduces to the smallest possible number the all-important staff of engineers, is carefully concealed from him. An efficient navy cannot exist without good ships, but neither can it exist without good men, and though both are desirable it is a fact that "good men with poor ships are better than poor men with good ships." But the citizens of this country, ignorant of the true condition of the navy personnel, are to a large extent following in the footsteps of their law-makers and have become so impressed with the ships of the navy as to ignore the necessity of an efficient and united body of officers to command them. Thirty years of comparative neglect of this the greatest source of any navy's strength, has resulted in a condition of affairs in our own navy that is dangerous to the nation and practically sets at naught its investment in ships.

THE PRESENT SITUATION.

Turn from admiration of our ships to inquire into the official personnel and regulations of the navy and what do we find? Officers who should be at peace with one another and united in their efforts to advance the efficiency and effectiveness of the navy, divided into warring camps, the smaller of these camps on the defensive and the larger bent upon the subjugation of the smaller to a condition of humiliation and degradation! We find many true and noble men in all ranks of the service, but we also find abundant evidence of the existence in the larger camp of a class or clique of officers better versed in the business of politics and intrigue than of war, busily engaged in practicing on land the arts of trickery and political wire-pulling while professing to be of the stuff from which the heroes of the sea are made, and guilty of such gross acts of oppression and injustice to their fellow-officers as to make it questionable whether they are not so utterly devoid of patriotism and manliness as to be unfitted to command either in peace or war! We find the engineer officers, the smaller of these warring camps, reduced in numbers until they are not physically able to properly perform all the duties pertaining to their offices, subjected to many petty annoyances, deprived of their rights and humiliated in the eyes of their subordinates! These engineer officers, highly educated, skilled in the sciences and applied mechanics, to whose abilities we owe the existence of our new navy, and without whose services it could not be maintained or its ships operated for a single day, treated by line officers as if they were merely uneducated engine drivers! Line officers can be found assigned to duties for which they are wholly incapacitated by training and education, and drawing salaries for which they give no adequate return to the nation! And the entire service weakened by the intrigues of men who have taken unto themselves powers which are vested in the people and the legislators they have elected, and are using those powers to limit the usefulness of better men than themselves, and to prevent the enlargement and improvement of the engineering branch of the service!

We are perfectly aware that these are severe words, and they would never have been written if there was any hope that reform could come from within the navy; but there is no such hope, and the treatment which the clique of line officers see fit to accord to the engineer officers—and to other line officers who will not bow to them—is so despicable in itself, so unjust to a loyal and honorable branch of the navy, and so injurious to the service, that it calls for action on the part of those who love their country and desire fair treatment for those who serve it, even if a condition of affairs is made public that is humiliating. Our readers have read something of these troubles in the pages of this and other journals, and we trust they will join in the protests that are now coming from many sources, and use their influence to bring about a better state of affairs. They can do this through their Congressmen and through the engineering societies and other organizations of which they are members.

The Wilson-Squire bill, presented before Congress last Spring, will come up again in the next session. It provides remedies for the worst evils in the present organization of the navy personnel, and every section of it can be safely endorsed. Are the thousands of men in the engineering profession in civil life

going to lend their influence to bring about a more effici nt organization, and to righting the wrongs of their brother engineers in the navy, or must the naval engineers fight unaided the battle that has been forced upon them by the line officers?

THE STRENGTH OF THE ENGINEER CORPS.

The present condition of affairs is traceable to the introduction of steam propelling power and machinery on board of the modern man-of-war, and to understand the situation it is necessary to go back over a period, which, though short, witnessed prodigious changes in naval construction and warfare. In 1839, or only 57 years ago, the United States did not possess a single war vessel propelled by steam. The commanding officers at that time if skilled in seamanship, navigation and gunnery, possessed all the technical knowledge necessary in their positions. Their successors of the present day constitute what is known as "the line." In 1839 Congress authorized the construction of the first United States war vessel fitted with propelling engines. This boat was the *Princeton*, built upon the plans of Captain John Ericsson.

In the same year the construction of two other steamers was authorized, and as there was no established corps of engineers in the navy to design and construct the necessary machinery, the Navy Department appointed the late Charles W. Copeland to superintend this work with the title of "Principal Engineer." With the steam engine came the specialist; engineers had to be obtained to run the engines. It is perhaps not surprising under the circumstances that the engineers should be only warrant officers and were below carpenters and sailmakers in rank, for the importance of the steam propelling machinery was not then realized.

Steam power on war vessels had come to stay, however, and, in 1861, at the opening of the Civil War, the government had in commission 52 sailing ships and 37 steam ships. Comparatively simple and small as was the machinery on board these 37 boats, we find there were 174 naval engineers in the service, while the line officers numbered 671 for the 89 ships of steam and sail.

With the exception of the six years immediately preceding the war nothing had occurred in this period to change the status of the engineers or to make Congress and the country realize the important part they were to play in future naval operations. But during these six years the boiler and engine power in new vessels was increased considerably and there had entered the service a corps of very strong men, nearly all graduates of the Renssalaer Polytechnic Institute. In fact, we had vessels like the *Minnesota* and *Merrimac*, superior to anything possessed by other nations. The status of the engineer had improved to the extent that he was now given "assimilated rank." What fine shade of meaning was conveyed by that term it is difficult to comprehend, but it gave the engineers no power to command and they were considered as non-combatants. We have also seen that in numbers the corps was very small. But the Civil War opened the eyes of every one in the navy to the importance and value of their services, and the needs of the navy compelled a great relative increase in the number of engineers as compared with line officers. The ratio between the two was changed materially. Thus, in 1864, or when the Civil War had placed the navy upon a fighting basis, there were 2,846 line officers and 1,728 engineers, regular and volunteer, in the service. There were in all 617 vessels, steam and sail, and if the sailing vessels are thrown out of consideration there were more engineers than deck officers for the steam vessels. In 1865 the numbers had risen to 2,463 line officers and 2,279 engineers.

In 1866, when the navy had been placed on a peace footing, there were 395 line officers and 379 engineers, thus showing that while in war the force of engineers was of necessity almost as great as that of the line, in times of peace with the experiences of a late war vividly before everybody, the need of an efficient corps of engineers was recognized, and practically the same ratio between the numbers of line and engineer officers maintained as had existed in the war. In that year there were 320 vessels in the navy register, the largest of 5,090 tons (old measurement) and the smallest of 50 tons (old measurement), and though the displacements of all the vessels are not on record, the 121 whose records are available show an aggregate tonnage of 119,561, or an average of less than 1,000 tons. The exact horse-powers are not known, but they averaged from one-quarter to one-third of the displacement, or say about 300 horse-power per vessel. A little calculation will show that the number of line officers was one for about each 800 tons displacement, and that the engineers each looked out for about 300 horse-power of machinery.

The importance of the engineer was now so evident that an intense jealousy sprang up in the line against them, and every means available was employed to keep them down. The result of this jealously of the line is seen in the naval register of Jan. 1, 1886, just before the first vessel of the new navy went into commission. Then we had only 73 steam vessels, which included serviceable vessels, those requiring extensive repairs and others launched but awaiting appropriation to complete them. This number also included 13 tugs, one or two of them useless, and others of but little efficiency. In addition to the steam vessels we had 12 wooden sailing vessels. The displacement of the 73 steam vessels was 132,075 tons. The tonnage of the 12 sailing vessels was 23,586. With the exception of a few vessels which were built of iron, the horse-power of the several ships was about what it was in 1866, since we possessed at that time practically the remnants of the war navy. But on this same date, Jan. 1, 1886, the register shows that we had 733 line officers, and only 221 naval engineers in the service! Eighty-five vessels, 13 of which were steam tugs, and 733 line officers! One line officer for each 212 tons displacement, as against 800 tons 20 years previous! It should be borne in mind that during all this period engines were auxiliary to sails, and the ordnance had not changed materially, so that the duties of line officers required practically the same knowledge as in the beginning of this period. Why, then, this enormous increase in numbers and the decrease in the number of engineers?

Then came the new navy with its absence of sails, its great steel ships, enormous propelling engines, high-power guns and complicated machinery. Our readers need not be told that it is an engineer's work to design all the machinery of such vessels, and to care for and operate that machinery in service. But on Jan. 1, 1896, we had 108 vessels in commission, aggregating 285,466 tons displacement and 317,275 horse-power, 714 line officers and only 173 engineers, or one less engineer than just before the war, when there were only 37 steam ships in commission and not one of them with engines of more than 1,000 horse-power—and less than one-half as many as in 1866. And yet in this period the number of line officers were nearly doubled.

Nor has the status of the engineer improved much during this period. Congress tried to give him the much-needed rank and authority in 1871, but the line had the word "relative" inserted in the bill before the word "rank." This was objected to by several members of Congress, but upon receiving assurances on the floors of both Houses that the word would not abridge the rights and authority of the engineers, it was allowed to remain in the bill that became a law. Once a law, the line snapped their fingers in the faces of the engineers and told them that relative rank was no rank, and that the Congress which had meant to do so much had actually done nothing. This shows the power of being able to interpret a law—a prerogative which is the province of the judiciary, but which has been seized by the sailor officers.

This brief sketch throws a little light on some of the doings which have brought the naval forces to their present status. Loath as one may be to believe that a "machine" exists, does anyone suppose that without undue and baneful influences at work the creation of a new navy of steel ships, involving the highest knowledge of steel construction, steam engineering, electric and hydraulic engineering—all the province of the engineer — would be accompanied by a great increase in a branch of the service that has a superficial, if any, knowledge of these matters, and a decrease in the branch that is expert in them? We might go into many details to show that improper influences have been and are at work, and that the great increase of the line and decrease of the engineer corps was not the result of natural causes, but due to a pernicious activity of a por-

tion of the line, but we deem it more important at this time to exhibit the present weakness of our navy and to state the changes necessary to remove that weakness than to show up the clique that has brought about the existing conditions. Besides, in exposing the weakness of the navy we incidentally air the methods of the "machine."

THE ENGINEERS OVERWORKED.

There are many evidences at hand that the engineer officers are overworked and the safety and efficiency of our magnificent fleet endangered thereby. We have already shown how their ranks have been steadily depleted as the number of modern vessels has increased—a fact which is proof enough in itself. Furthermore, members of the engineer corps are constantly breaking down in health in the discharge of their duties at sea. We can recall many cases already this year, and if we went back over the records the list would be a most formidable one. In our September issue we recorded the breaking down of two engineers on the *Indiana* or one-half of the engineer force on a $5,000,000 ship. A few days ago two engineers on the Asiatic squadron broke down, leaving this squadron on the other side of the globe with a force of 10 engineers only. The reasons for these breakdowns are easy to be found. A vessel goes to sea with such a small complement of engineers that these officials have sometimes to take watches for 12 out of each 24 hours. The vessel has so many line officers on board that these men have known to be on duty only four out of 24 hours. The engineers have direct charge of one or two millions' worth of machinery below decks, and they and their men are working in a temperature of from 150 degrees to 170 degrees. The deck officers navigate the boat and have charge of the men who scrub decks, polish the bright work, and do police duty, and they perform these onerous duties in the fresh, bracing air. Is it any wonder that the engineers break down and that the breaking down of a line officer is unheard of? Chief Engineer Tower, of the *Indiana*, had been on duty continuously for 36 hours when he succumbed to the strain.

To show how short-handed is the engineer force on some of the boats in which the taxpayers have invested millions, let us make a few comparisons. The *Minneapolis*, a 23-knot triple-screw cruiser, 7,375 tons displacement and 21,000 horse-power has 90 separate engines, with a total of 172 steam cylinders. She has at present three engineers and three cadets under instruction. She is supposed to have four engineers, but one of the engineers on the European station recently broke down, and now they are short-handed. The American line steamer *St. Louis* of 16,000 tons displacement has about 20,000 horse-power. We don't know how many separate steam engines are on board, but evidently they are less than on the man-of-war. She has four senior engineers, 15 junior engineers, 2 electric engineers, 2 refrigerating engineers and 1 deck engineer, or a total of 24, to say nothing of 6 cadets.

On the *St. Louis* we find no grade between engineers and the oilers and firemen except two storekeepers. On the *Minneapolis* there are supposed to be six chief machinists at $70 per month, six first-class machinists at $55 and five second-class machinists at $40 per month. When we consider that a man-of-war must be in a large measure independent of docks and repair stations we might well look on these machinists as the repair gang. The chief machinists are supposed, however, to be capable of taking an engine-room watch. The first-class machinists need be only machinists with some knowledge of marine engines and boilers, while the second-class machinists need have no experience at sea whatever, with marine engines. Evidently, if there were six chief machinists capable of standing a watch the situation would still be pretty bad. But so inadequate is the pay and so galling the service in the engine and fire rooms of our men-of-war that the government cannot get men to enlist as chief machinists in sufficient numbers. Men intelligent enough to be trusted alone on an engine-room watch can get better pay on shore. And on shore they don't have to sleep in hammocks spaced in some cases only 13 inches from center to center, and to turn out in the early morning with the deck hands after working nearly all night on repairs or other emergency work. On the *St. Louis* all the junion engineers have bunks and can have undisturbed rest after such duties. It is not so with the chief machinists. What is the result of all this? On the *Minneapolis* there is only one chief machinist! There are 11 first-class and 1 second-class machinist on board. Consequently where the *St. Louis* has an entire engineer force of 30, including cadets, the *Minneapolis* has three engineers and one machinist capable of taking a watch, and three cadets not yet graduated from school, or a total of seven persons, only three of which are worthy of the title of engineers, and really ought to be trusted implicitly with the care of the machinery. On the *Minneapolis*, now in the Mediterranean, the Chief Engineer is probably taking a watch of four hours himself, besides attending to his duties in connection with the supervision of the entire engineering force, the other engineers and the chief machinist are on duty 10 hours out of the 24, and what these men can't oversee of this immense engine, boiler and machine plant, worth more than $1,500,000, is of necessity intrusted to machinists paid $55 or $40 per month!

Another startling condition of affairs is found in the firerooms. These are in the immediate charge of the water tenders paid $40 per month. It must be borne in mind that these boilers are in several compartments separated by bulkheads in which all doors are closed when the ship is underway. Here are, say, 21,000 horse-power of steam generators with feed pumps, ash hoists, bilge pumps, etc., etc., under the charge of $40 per month men. The engineers on watch can give but little attention to the fire room with their present numbers. The line believe that there should be a commissioned officer on deck for every small gun carried. Why should there not be a commissioned engineer officer at all times in every one of the six compartments containing the propelling machinery? Would not the safety of the vessel be promoted thereby and the expense of maintaining its machinery be reduced by such complete and intelligent supervision? The highest naval authorities are agreed that the salaries of these additional officers would be more than saved by the reduced repairs. We would point out that these additional salaries in the engineer staff could be provided for by reducing the number of line officers, of which the *Minneapolis* carries nine, besides four cadets.

It is proper to note that the pay of machinists in the navy and their duties are decided, not by the engineer officers, but by the Bureau of Navigation. To read the schedule of pay and duties will convince any intelligent reader that they were never prepared by men familiar with the requirements of the engine room force on board ship.

In the British navy there are 1,739 line officers and 795 engineers—a ratio of 2.18 to 1. In our navy, as already stated, there are 714 line officers and 173 engineers—a ratio of 4.13 to 1. Thus we have relatively only one-half as many engineers as in the English navy; and it should be borne in mind that great pressure is now being exerted in favor of an increase in the number of English naval engineers because of the inadequacy of the present force.

If any further testimony of the overworked condition of the engineers is needed it can be found in the report of the Surgeon-General of the Navy for 1895, where he calls attention to this fact in words that leave no room for doubt.

EXCESSIVE NUMBER OF THE LINE OFFICERS.

There is, therefore, no escape from the conclusion that the engineer corps is in numbers far below what is necessary to operate and properly maintain our ships. The zeal and ability of the 173 on whom the duties fall have prevented until recently a full realization of the actual situation. But though the engineer corps is so small as to make it impossible to perform certain shore duties in connection with the building of new vessels and the repairs of old ones, there is no shortage in the "line." Out of a total of 714 officers, there were, Jan. 1, 1896, only 338 attached to vessels at sea. Of the 376 on shore, 91 were on duty at Washington; nine were running a war college that holds sessions in the summer months only, and whose average attendance is about 25; 51 officers were running a naval academy at which there are only 241 cadets in attendance; at Newport there are, in addition

to the 9 officers at the war college, 12 at the training ship and torpedo station, but not one engineer; at the Boston Navy Yard there are 8 line officers and only 2 engineers; at Mare Island there are at the receiving ship and navy yard 13 line officers and 7 engineers; at New York there are altogether 23 line officers and 17 engineers. But perhaps the inspection of steel furnishes the most surprising examples of the employment of line officers to the exclusion of engineers. The steel board is composed of two line officers and one engineer. The inspection of steel and armor is performed by 6 line officers, 2 engineers, 1 carpenter and 2 sailmakers! The inspection for the Bureau of Ordinance is done by 6 line officers. So that out of the 20 officials concerned in the steel inspection there are 3 engineer officers, or the same representation as is given the carpenters and sailmakers! Is any comment necessary?

THE STATUS OF THE ENGINEER.

Essential to the efficiency of the service as is an increase in the number of engineer officers, a better official status which will make the organization attractive to scientific experts is equally so. At present, the naval engineer is denominated a civil officer, although exposed to as great danger as the man protected by the walls of the conning tower. He is termed an "adjunct," "auxiliary," "noncombatant," and the watch bills of some of our warships will show that he is also officially designated as an "idler." He is given what is termed "relative" rank, but when the fact is comprehended that he is not officially regarded as a military officer it is unnecessary to state how discredited and unsatisfactory the possession of relative rank is. By reason of not possessing military rank he is subject to the beck and call of numerous underlings claiming to be invested with the prerogatives of the commander. As Professor Hollis has epigrammatically said, the conferring of relative rank simply permits the Department "to fix precedence so that there be no dispute about the order in which officers select their rooms on board ships, march in funeral processions, approach and bow before the President at a New Year's reception, or sign their names on official papers."

The status of the naval engineer will not be properly recognized until he is given absolute military rank, for the line have never recognized the possession of relative rank by the engineers as giving the corps a military status in the service. The spirit of this contention has been expressed by one line advocate in these words: "Equality with line officers is simply absurd. You may depend upon it that any amount of money and political influence will be forthcoming at the proper time, if necessary, to resist the unparalleled impudence and assumption of the subordinate branch of the navy to the honors and dignities of the line."

The engineer officer on board ship thus finds himself in a discredited position, where he is unable to carry on his work to the best interest of the nation. He is nominally "in charge" of the entire engine-room and fireroom force, but a deck officer who is his junior may assume prerogatives which will demoralize and disintegrate an organization which the engineer has been perfecting for months. Even when the commander is within speaking distance of the officer of the deck the subordinate line officer claims to be in charge of the ship, and the line even goes so far as to maintain that the naval cadet who is on probation when temporarily in charge of the deck can presume to assert such authority over the engineer and his department, A fitting *finale* to such an organization is a corps of prostrated engineers, a fleet of ships which are inefficient, and a service that is badly crippled for the work of war. Surely its weakness only needs to be pointed out to have Congress effect radical reform.

It is not surprising that with a powerful "machine" in existence, and with the engineer corps without proper status, justice should miscarry in many courts-martial, the favorites being protected and others unduly punished. Mr. Mattice, formerly of the naval service and now a distinguished consulting engineer, gives a summary of many courts-martial; we cannot go into the figures at length,* but the navy records show that two trials of line officers for cowardice resulted in the offenders receiving sentences aggregating three years of suspension, and a total loss of six months' pay; of twelve cases where ships were lost apparently through the fault of line officers, seven cases were never brought to trial, and in four cases the suspensions aggregated 9½ years, or an average of only 14¼ months for each officer implicated, all suspended officers being paid from three-fourths to full pay during the periods of their punishments, while in the twelfth case the commander was dismissed from the service, as it was shown that he was intoxicated at the time his vessel was lost; in six cases of vessels aground, four were never tried and the other two resulted in nine and ten months' suspensions respectively for the captains; a serious damage to a ship in docking was punished by six months' suspension of a line officer; drunkenness on duty, two months' suspension. In all of these cases the parties were in the pay of the government during the suspension, often under full pay, except where we have noticed to the contrary. But a past assistant engineer a year or more ago was tried for being absent without leave while his ship was tied to the wharf of a navy yard and he was sentenced to one year's suspension on furlough pay (one-half of "waiting orders" pay) and to lose all promotions in that period, which resulted in his losing ten numbers on the list in his grade. Other cases of equal discrimination could be cited. Admirals too honorable to toady to the "machine" and secretaries of the navy have remonstrated in vain at the inadequacy of the punishments meted out to line officers and have set aside as perversions of justice many of the sentences against engineers. The daily papers recorded such a case only last month. Any intelligent person can realize that such discrimination between line and staff officers fosters a spirit of bitterness between officers and men alike, and that the unjust treatment of engineers in courts-martial and in all matters involving authority and discipline is resented by the entire engine and fire room force of enlisted men. These men are often badly treated themselves by the deck officers and they know by bitter experience their own officers are helpless and that they can turn to no one who understands them and their work.

Shore duties also furnish several good illustrations of the evils arising from this lack of authority in the engineers, one of which is found in the inspection of steel already noted. If any private concern bought hundreds of tons of steel at a cost of $500 per ton it would exercise every care to see that the material was properly inspected, but the armor for the navy is inspected by line officers who certainly cannot be expected to know as much about steel as the engineer. How was it possible for the armor frauds of several years ago to be perpetrated upon the government if the inspectors were capable? Why were these frauds hushed up? Would they have been hushed up if the inspectors had been engineer officers? As another illustration, turn to our navy-yards and arsenals. Here we find these great building and repair establishments under the control of line officers and so firmly in the grip of military rule as to make the time required and the cost of the work done by them much greater than the best authorities believe would be required under a supervision of trained engineers. Would any private manufacturing establishment place millions of capital and a working force whose pay roll aggregates many tens of thousands per month under the control of men not trained in engineering or of engineers with limited authority?

Even the design of our ships are not free from these influences. Some of our great battleships might be faster than they are if the bureaus of steam engineering and construction could get an unprejudiced hearing for their opinions. The electric plants on these vessels have been taken from the control of the engineers and operated by the line until they break down, when the former are sent for to repair them. These plants must now be located to suit the convenience of the line officers, regardless of whether such locations are the best. Nay, more; the steam pipe running to the dynamo engines must not take steam from any steam main, but must tap the boiler itself. An extra hole must be made in the boiler and a hundred feet of extra steam piping, more or less, must be provided to give to the electric plant of the "line" the necessary isolation from the domain of the engine-drivers! The naval attaches in foreign countries are maintained

* We would refer our readers to Mr. Mattice's open letter, "Queer Doings in the Navy," and to a valuable article by Mr. Wm. Ledyard Cathcart in *Cassier's Magazine* for October.

in those positions chiefly for the engineering information they can pick up for the department at home. Of course they are engineers. Nothing of the kind. They are line officers without training for such duties. The country no doubt will be amazed to learn that the education of these line officers, preparing them for the most desirable duty of naval attaché abroad, is accomplished in 10 or 14 days. Previous to taking their departure for Europe to perform the engineering duties required of a naval attaché, they receive a roving commission to visit the largest engineering establishments in this country. The very fact that they undertake to study American methods in 10 or 14 days shows their absolute incompetency for the work. The only advantage they derive from this tour of inspection is that they receive eight cents a mile while making a pleasant excursion at the expense of Uncle Sam.

It was through one of these brilliant attachés that the government spent a large sum for the purchase of plans in England for the *Charleston*. In a discussion before the Engineering Congress at the World's Fair, Mr. Mattice gave some information about these plans that shows how competent was the attaché. The plans were supposed to be those of the *Naniwa-Kan*, but the general plans were those of the *Etna*, and the details were of the *Naniwa-Kan* and *Giovanni Bausan*, "and there were one or two of a rather chestnutty flavor that would not fit in with anything else." The Secretary of the Navy ordered these plans to be followed closely, and as a result costly changes had to be made as the work progressed, and the vacuum pumps had to be discarded and new ones built at a cost to the government of $50,000. Another set of plans purchased in England were not quite so bad, but many changes were made in them by the bureaus of steam engineering and construction before the *Baltimore* was built from them.

THE OPPOSITION OF THE "MACHINE."

The machine fights tooth and nail the proposition to improve the number and status of the engineers, and insists that any increased authority given them will demoralize the service. They charge the engineers with a desire to get everything in their power. As this article is in course of preparation, there comes to our desk a copy of the *Army and Navy Journal* for Oct. 3, containing an article written by a line officer. In this article he says: "The engineer feels that since modern vessels depend entirely upon steam for ability to use their guns, and since engines depend on trained knowledge, and since he must undergo danger without the line officer's privilege of striking back, *he should have the best of everything.* It is suggested that the naval engineer is on a plane with the scientific army engineer, and it is proposed *to make the naval engineer the leading officer of the navy.* They forget that their basis is engine-drivers." The italics are ours. The supposed claims they emphasize are fictitious and false. The engineer does not ask for the command of vessels, but he does believe that the good of the service and his own honor alike demand that he be under the authority of the commanding officer of the vessel and not at the beck and call of every officer of the deck, even an ensign. He does believe that the good of his branch of the service demands that his present "ralative rank," which is title without authority, be changed to a positive rank by which his titles will mean something. He does believe that the deception now practised upon the people of the nation, by which engineer officers appear in civil life and on state occasions with the honors of their titles, but on board ship are stripped of it all, is a farce that endangers discipline and engenders discontent and strife among the entire crew.

But the line officer we have quoted above is really anxious about the engineer. Hear him again: "The engineers want too much, but that is no reason why they should not have justice. *Let us do justice.*" Need we go any further for evidences of a clique? Has it come to this that the line officers announce to this nation that through the line, if at all, justice is to be meted out to the engineers? We admit that proposed changes in the navy affecting the authority of officers might properly originate with the line in which the right of supreme command is vested, but there is little hope that they will. We quote again: "The line is the corps of command, and must be. Nothing the engineers may do can alter that. . . . When the engineers recognize that command is essential and must go to the line, then it will be possible to institute a new plan that will give them justice. If they can once see that *the corps of command is the navy*, a reform can be made that will give them a share of the honors of war. I suspect that the real bitterness of the engineer's fight has lain in the feeling that he belonged to a body of men who are expected to do the dirty work, accept danger in the dark and get none of the credit of success."

The corps of command is *the* navy! This is on a par with the insolence of the line officer who told an engineer that he (the engineer) was *in* the navy but not *of* the navy. The engineers, a body of men who are "expected to do the dirty work, accept danger in the dark and get none of the credit of success"? Who expects them to do this? The line officers may, but does the nation? The real bitterness of the engineers' fight has lain in the fact that he knew the nation thought he was getting his due credit, whereas it was being systematically withheld from him. But the last quotation relieves us of the necessity of proving that engineers are unjustly treated under the present order of things, for this line officer expressly admits that they are.

HOW A NAVAL RESERVE CAN BE OBTAINED.

Then both justice and the immediate needs of the service make it imperative that the engineer corps be increased in numbers and that the engineers be given rank equal to their confreres in the line and an authority that will make that rank respected. But another and an equally good reason exists for raising the status of the engineer. If the number of engineers is to be increased and an adequate reserve is ever to be provided for the time of war, inducements must be offered to get men for the service. They will not enter it in sufficient numbers under the present conditions. The engineers already in the navy would resign from it with little delay, did not loyalty to their country and the hope of finally receiving justice from her hand keep them in her service. Even as it is resignations have been numerous, and the number of engineers graduating annually from the naval academy is not sufficient to balance the loss from breakdowns, deaths and other causes. If honorable positions in the navy are with in the reach of graduates of our technical schools and colleges, many will avail themselves of the opportunity—but not until the engineer is accorded justice. And if war should ever come, ex-naval engineers and others in private life will not offer their services to their country—where such services involve a degradation. It may be argued that loyalty should bring the engineers into their country's service in time of dire need, regardless of questions of rank and title. It should not be forgotten, however, that the greatest of patriots are always the manliest of men, and that a nation which wants the services of noble men in time of war should not neglect the present opportunity to make that service an honorable one.

The engineering profession of the United States have pointed out the naval weakness to Congress and the people, but they have done more than that—they have shown what remedies should be applied. The Wilson-Squire bill, already mentioned, introduced in the House by the Hon. Francis H. Wilson, of Brooklyn, N. Y., should be the basis for all naval legislation enacted for the personnel. If the engineering profession will continue to display its interest in this bill, Congress can be made to realize the crippled condition of the navy, and the bill thus become a law.

TESTING CAST-IRON CAR WHEELS.

In one of the earlier articles on the Altoona shops, which appeared in these pages, an account was given of a method of testing car wheels by pouring molten cast-iron around the treads, the wheels being laid in the mold with their backs or flanges down. As was then described, a sand mold is made around the tread of the wheel which leaves a space of about .2 inches wide between the sand and the tread. Melted iron is then poured into this space. Most of the wheels that have been tested in this way, it was found, broke or cracked in from 25 seconds to 1¼ minutes from the time the metal was poured. The inference from this was that if wheels are broken by heating them in this

way they will also be broken by the heating action of brake-shoes when these are applied, especially at high speeds.

It may be said here, incidentally, that mankind may be roughly divided into two classes, one composed of people disposed to entertain new ideas, and the other of those who are not, many of whom have a positive disinclination to give consideration to any subject, or credence to any facts, or accept any process of reasoning, of a kind with which they are not familiar. Many such people, too, are born objectors, and are possessed of a wonderful capacity for finding reasons why things are not so. They are like the lawyer who was consulted in that well-known case of the prisoner who was incarcerated for a certain offense, and who was told by his legal adviser that a person could not be put in jail for the act of which the prisoner had been guilty. "But I am locked up," the client pleaded, but that fact would not change the opinion of the lawyer.

With the class of people referred to facts have no more weight than the lawyer was willing to assign to the curtailment of his client's liberty. It is in vain, in arguing with such people, to bring incontrovertible evidence to establish certain facts. They are deficient in the capacity of believing, which the Scriptures teach is a means of salvation and assure us that neither would such people believe although one rose from the dead.

This digression was suggested by the way in which the account of the thermal tests of wheels at Altoona, which was published in these pages some months ago, was received by some of the readers of the AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL. One correspondent said the test was "sensational." Others said it was not new and some of the wheel-makers thought it was not fair. All admitted that car-wheels are often heated by the application of brakes, but then they say they do not get "so very hot," or they are not heated so quickly by the brakeshoes as they are by the melted iron poured around them. Now as a matter of fact no one knows with any degree of certainity how hot a wheel gets when brakes are applied on a car. One case is reported of a wheel, broken in service, which was so hot an hour after the accident that it could not be touched without burning the toucher. Imagination only can infer how hot it was when broken. As a matter of fact wheels are not "very hot" when they break under a thermal test. They often crack within 25 seconds or less time after the pouring of the metal. Not a very high degree of heat can be transferred to a wheel in that time. Who knows how quickly or to what degree a wheel will be heated if an "emergency" application of the brakes is made when running at the rate of 60 or 70 miles per hour?

Another resource of the doubters is that any innovation in their experience or practice is not new. Even if it is not, the *utility* of it is not affected thereby. Would a reasonable human being object to using any useful information, even if it was exhumed from the catacombs, or dug up from the foundations of the pyramids, and was as old as Egyptian civilization. Wisdom and knowledge don't deteriorate by age if they are really either wise or true.

Some of our readers who are inclined to *dubiosity*—if there is such a word—say that the thermal test is not a practically fair one, and is calculated to unduly alarm the traveling public. Nevertheless, the Pennsylvania Railroad officials at Altoona have been developing the test, and have reached the conclusion that in specifications for wheels which they buy that a certain number in each lot received shall be subjected to a test of this kind, and if they do not stand it all are to be condemned. An extensive series of investigations were made before this conclusion was reached. More than 200 wheels were tested, of which a large proportion—about nine-tenths—were broken or cracked. The fractures were very curious. In a large number they occurred just inside of the rim and extended circumferentially for a distance varying from a fifth to a third of the way around. In some cases the wheel was merely cracked, the fracture not extending through the rim, but in others the rim was broken radially to the circumferential crack, and a piece was entirely detached from the body of the wheel. In others the break would be on a line approximating to a chord drawn to the periphery of the rim or tread. Another form of break was on a circumferential line, about half way between the hub and rim, or where the double plates join the single one outside of them. (Nearly all the wheels tested were of the Washburn, so called, double plate pattern.) These cracks also extended from a fifth to a third of the way around, and were sometimes confined to a circumferential line and in others would extend radially from one or both ends out to or through the rim. In some instances these fractures were mere cracks, while in others a piece was bodily detached from the wheel. Often the break occurred before the molten iron had solidified, and with such violence that it was scattered out of the mold in a way that was dangerous to the bystanders. Another curious phenomenon was the fact that often a secondary fraction would occur after the first one and on the opposite side of the wheel. The two would not always occur at the same part of the wheel section nor in the same form. Some or all of the brackets or ribs were broken in nearly or quite all the tests even when the plates were not fractured. Mr. McLean, the superintendent of the foundry, who made these tests, obtained five double-plate wheels of the old pattern made by the Lobdell Company in Wilmington, Del. What is called the Washburn double-plate wheel, which is the pattern now in general use, has not in reality double plates, as the two plates extend only about half way from the hub toward the rim, and there they unite in one plate which extends to the rim. The Lobdell however, has two full plates, which extend all the way from the hub to the rim with a space of from about 4 to 6 inches in width between them. The plates are slightly curved. None of these wheels broke into pieces; several of the outside plates developed short circumferential cracks, which did not destroy the integrity or the wholeness of the wheel, and it was only the outside plate which was fractured. Altogether they stood better than any other form that was subjected to the test. It would be curious if it should be found advisable to revert to this old pattern of wheel, which was abandoned twenty-five years ago or more—or to something similar to it. This form is to be subjected to a thorough series of tests to ascertain what its real merits are.

Another fact which was ascertained was that wheels which had been in service, or second-hand wheels, did not stand the test as well as new ones. This is contrary to Mr. Outerbridge's theory that cast iron grows stronger if subjected to frequent concussions. Of course it may be that the endurance of these double-plate wheels was due to the quality of the metal in them. It is intended in the investigation which will be made to ascertain how they will act if made of the same material as the wheels which fail. Altogether the Altoona wheels have stood the tests better than any others, excepting the double-plate Lobdell pattern. Some of the Altoona wheels were broken, but many of them stood the test without fracture. It is proposed hereafter to take three wheels from every hundred, and subject one to a drop test and two to a thermal test by making a mould 1½ inches wide around the tread and then pouring iron into it, these wheels to stand two minutes without breaking. The time and the space may possibly be modified if experience shows that it is essential. The adoption of these requirements is quite certain to lead to efforts on the part of wheel-makers to devise forms which will resist thermal strains more successfully than the so-called double-plate Washburn pattern will or does. It may be added that although nearly all the wheels tested were of that pattern, their forms, and especially that of the sets or brackets, varied considerably. The forms of this pattern of wheel which were tested seemed to have little influence in their capacity to resist the expansion of their treads by heat. As was pointed out in these pages before, the strain required to fracture a wheel, even if made of poor material, must be enormous. The area of the fractured section was often as much as 25 square inches. The force required to pull this asunder can readily be calculated. The new requirement of the Pennsylvania Railroad is likely to mark a new era in the manufacture of cast-iron wheels and must lead the makers either to use better material in them or devise new forms which will resist the new test, even if made of inferior iron.

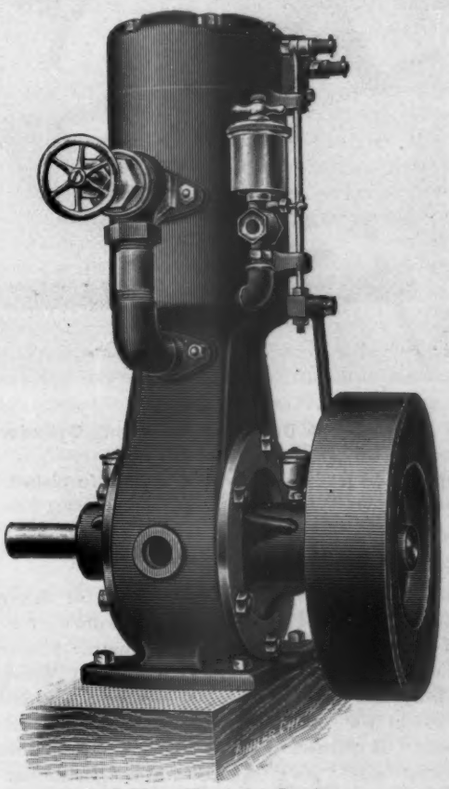
THE PROSPECTS FOR ELECTRICITY ON STEAM ROADS.

Progressive railroad officials, particularly those who are in a position to feel keenly the competition of the electric motor in suburban traffic, are fully alive to the progress and improvements in electric-power installations, and will not be slow to utilize this modern method of power transmission—for that is all that electricity is in its present uses in power plants—when it is possible to effect a saving by so doing, but we think few of them will join with the author of the paper on the "Motive Power of the Future," read before the recent meeting of the American Society of Railroad Superintendents, when that writer says: "We have arrived at a very interesting point in the evolution of railway motive power, a point of transition from old methods to new ones, a point from which it seems possible to almost certainly predict the entire change from steam to a more economical motive agent. . . . Unless, then, we make the assumption that we have reached the end of progressive development, we must admit the very great probability of the entire supersession of steam by electricity as a motive power on our railways, not only in suburban and interurban traffic, but in cross-country traffic also. Primarily, such change will take place because the perfection of economy has probably already been reached with regard to the application of steam." Nor do we think that those who are most directly concerned in the economical operation of the locomotive will agree with the opinion that the limit of possible economy has been reached in present practice. For some years past the economies sought in locomotive design have chiefly been those obtainable by a reduction of the total train expenses, rather than in the economy of the locomotive itself. As a result we have larger locomotives, heavier trains, engines that stay out of the shop longer—or make a greater mileage between shoppings—in fact, anything and everything in design and method of operation that will give the best net result on the capital invested and which will cut down the expenses per ton-mile. When all that can be has been achieved in this direction attention must then be given to the performance of the locomotive as a machine in itself to reduce to the lowest limits its coal consumption for a given duty; then, and not until then, will the l comotive reach its highest efficiency. The electric locomotive has made rapid strides in the last few years, but its best informed friends admit that under the present conditions it cannot compete with the steam locomotive for cross-country traffic. It is believed by many, however, that the developments in electricity in the near future will be of such a radical character that the cost of power in this form will be greatly reduced. If such a sweeping reduction in cost is effected there is hardly any question but that the steam locomotive will be left behind in the race. The economies which it is possible to effect in the operation of our much-respected friend, the steam engine, are considerable, but they are not extensive enough to be entitled to the term "sweeping." On the other hand the radical or sweeping changes in electric motive power necessary to permit it to take the place of the steam locomotive have not yet been made, nor is it clear that they are actually forthcoming. Many are deceived by the comparative youthfulness of electrical science into the belief that our knowledge of electricity is very incomplete and that remarkable developments may be expected at any time and from almost any direction. This is far from the truth. The discoveries in electricity came to a world of science capable of grasping their importance at once, and of pushing forward the work of investigation; they also came to an industrial world equipped with the knowledge and tools necessary for the construction of the new machinery, and the engineering ability to adapt this machinery to the wants of mankind. The result has been the development of electrical science and electrical industries with astonishing rapidity, until to-day they compare with many older sciences and industries in completeness. For these reasons it does not appear that there is, after all, so much to be expected from the further developments in electrical engineering.

Since the above was written, Dr. Chas. E. Emery has presented an excellent paper before the American Society of Electrical Engineers, in which he compares the present cost of operating a heavy trunk line with the expense of the same service by electricity. He shows that the fuel bill is only ten per cent. of the total expense of operation so that a performance at the central station of one horse-power for only two pounds of coal will result in a saving in operation of only 6.56 per cent. of the total expense after deducting the losses of transmission, etc. He concludes that there would be no saving in labor, none in repairs, and none in track maintenance. Furthermore, he shows that the great cost of the electric equipment will increase the fixed charges to such an extent that with money at 5 per cent. interest, the traffic income must be increased 12¼ per cent. to pay these charges. He argues that the use of electricity in suburban travel increases the business of the road for reasons which are already familiar to our readers, but he also points out that in long-distance traffic an increase of traffic due to the electric power cannot be expected. Others supported these views in the discussion and we may safely conclude that the electricians who best understand the traffic of steam roads are the least hopeful of the immediate use of electricity in that service. We shall again refer to Mr. Emery's paper and the discussion on it next month.

A New Naphtha Engine.

This engine, shown in the perspective in the accompanying engraving, presents some entirely new features in a boat engine, which render it especially desirable as a motive power for small boats and launches. It is built by Chas. P. Willard & Company, of



A New Naphtha Engine.

Chicago, which company owns the patents covering the special features.

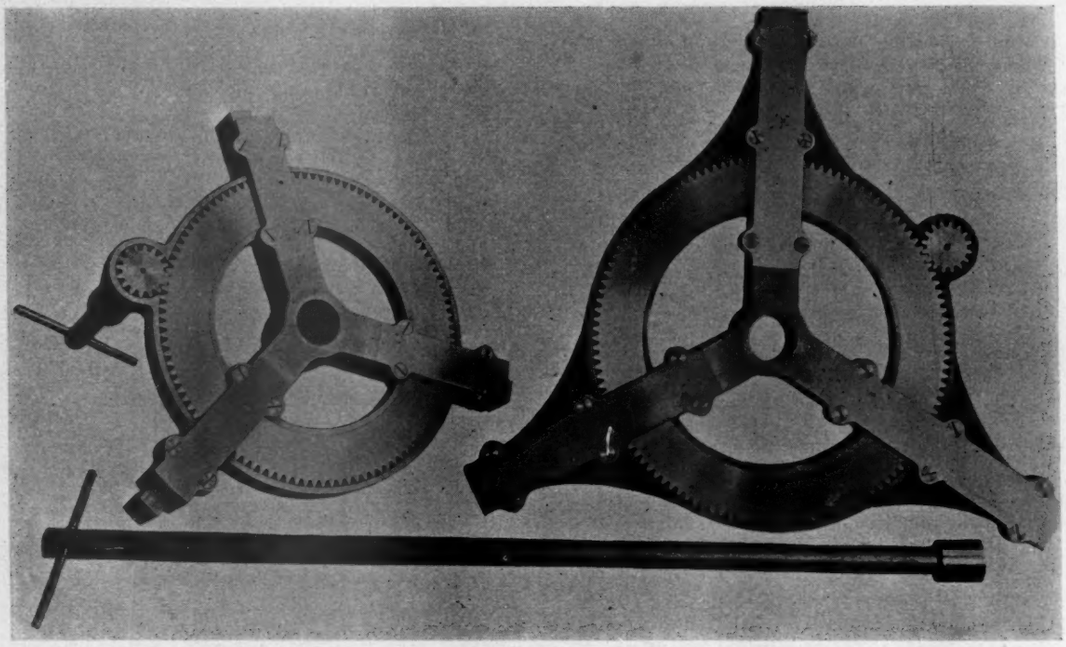
Heretofore, we believe, all naphtha launches have required the presence of a flame burning in the generator while it was in operation, to vaporize the naphtha, and also required the presence of several gallons of naphtha in the boat at all times. By the entirely different system upon which this engine operates, there is no fire in the boat whatever.

The engine is of the ordinary trunk piston type and the valve mechanism is of the simplest kind, consisting of a single eccentric working a lever operating two cams. There are no gears whatever.

When the engine is first started naphtha is vaporized to obtain an explosive mixture for the cylinder, but after a few minutes the engine is supplied with gas from a patented generator, which is not shown in the illustration. From this generator the gas enters the base of the engine at a point opposite the hole seen in the engraving. Through this hole air is admitted to the base, and the mixture, being slightly compressed by the downward stroke of the piston, passes through a throttle valve into the cylinder, where, after further compression, it is ignited by an electric spark.

One of the valuable features of the engine is its ability to use the lowest and cheapest grades of naphtha and gasoline on the market. There is also no flame in the boat outside of the engine cylinder. The engine can be operated at all speeds and in either direction. The amount of naphtha which is needed on the boat at any one time is much less than where it is used both as fuel and as a working vapor, and, as already stated, the oil can be of a low grade, say a 57-degree naphtha.

The builders, Chas. P. Willard & Company, are located at 197 South Canal street, Chicago, and will be pleased to furnish additional information. The engines are sold complete, ready to put into a boat, or boats complete and ready for operation will be furnished by the manufacturers.



A Device for Centering Cylinders.—Made by Pederick & Ayer Co., Philadelphia.

A Device for Centering Cylinders.

Those who have much to do with the erecting of locomotives or with repairing them will appreciate the neat device for lining up cylinders and guides which we show herewith. It is the idea of Mr. Pedrick, of the Pedrick & Ayer Company, of Philadelphia, and was made by him in response to a request for something of the kind for use in the erecting shop of the new locomotive works in Russia. It consists of a cast-iron spider or frame provided with three steel "jaws" operated in unison similar to the jaws of a universal chuck. Two pairs of spiders were made for the Russian locomotive works, one set for the high-pressure and the other for the low-pressure cylinders of compound locomotives. They are both shown in our engraving.

The steel jaws are neatly fitted into radial channels planed in the spider and are ¾ by 1¼ inches in section. Their ends are enlarged to give a bearing face 2 by 1¼ inches by an L-shaped extension of the jaws. On the face of these jaws rack teeth are cut to engage a spiral cut on the back of the large ring gear seen in the engraving. The jaws are held in place by plates which cover them and extend across the gear also. A small pinion held in the spider frame meshes into the large gear and, by means of a socket wrench on its spindle, the jaws are set out against the cylinder walls. A two-inch hole through the center of the spider is for the insertion of a turned bar or arbor which is thus held exactly central in the cylinder, and by which the guides are lined up.

It will be seen that the mechanism does away with the labor of adjusting a line or arbor to a central position in the cylinder. All that is necessary is to place the spiders in position, set out the jaws simultaneously and then insert the arbor. The latter is then located centrally and with greater accuracy than is ordinarily obtained.

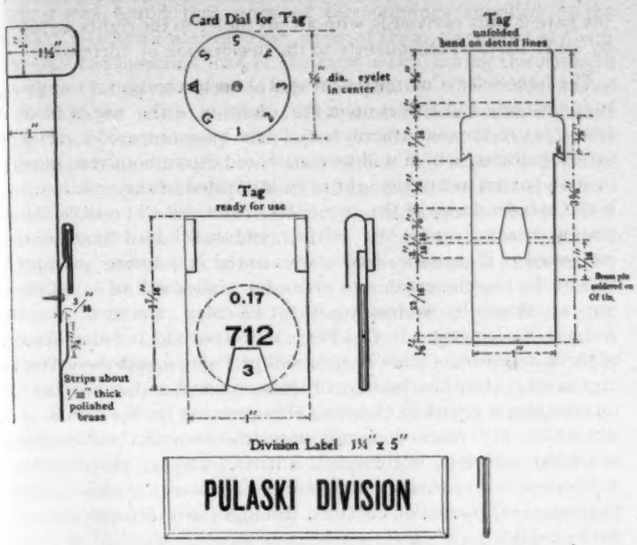
The larger of the two devices shown is 28 inches in diameter and will fit cylinders from 28 to 31 inches in diameter. The smaller one is suitable for cylinders from 19 to 22 inches in diameter. As each pattern can be given a range of at least three inches, two sizes would suffice for the average railroad shop.

The device has been praised so highly by those who have seen it that the company will add it to its line of manufactured products and is prepared to furnish it in any size required. The workmanship is of the best.

Norfolk & Western Engine Board.

In the latest number of the proceedings of the Southern and Southwestern Railway Club we find an article describing the engine boards of the Norfolk & Western road, by R. P. C. Sanderson. These boards are believed to fulfill all requirements and are easily and cheaply made. Referring to the engraving it will be noticed that the engine board itself consists of a plain pine or poplar board (shown in section), on to the face of which are secured by screws a succession of horizontal thin metal strips (brass, Russia iron, or something similar). The shape of these metal strips is shown by the drawing, and when in place they form a succession of horizontal grooves. The headings, names of divisions and shops are indicated by cardboard labels, slipped into the label holders, which are simply hung on the metal strips at convenient positions, and can be changed ad libitum to suit changing conditions, by shifting them about, taking them off, or changing the cards in the label holders. The label holders for the names of divisions are 1¼ by 6 inches and a sample one is shown. The shop tags are 3¼ inches by 5 inches.

The engines are represented by tags of a peculiar form, as shown by the drawing. The tag is made of a sheet of tin, of the



Details of Norfolk & Western Engine Board.

shape shown, which has a small piece of brass wire soldered to it to form a center for the cardboard dial. The dial is also shown separately, and the printing on it can be varied to suit the different requirements. In the case of the dials shown the marking has the following meaning :

1. Repairs required—No. 1—which means general rebuilding.
2. " " " 2—which means new firebox and general overhauling.
3. Repairs required—No. 3—which means general overhauling, with heavy renewals of worn-out parts.
4. Repairs required—No. 4—which means light general overhauling.
5. Repairs required—No. 5—which means light repairs, such as can be done in four or five days without removing wheels.

S. Repairs required—Special—which means such as broken frame, broken wheel, 50 flues, etc.

W. Repairs required—Wrecked—only used in case of heavy wreck damage.

G. Means in good or fair order, in condition to render efficient service, and requiring nothing but current maintenance and running repairs.

After the tin is cut, the center pin soldered on, the dial is dropped on to the center pin, and the tag folded over to the shape as shown on the drawing of the completed tag. The notch or gap in the tag allows one of the figures or letters mentioned above as indicating the condition of the engine to show, as the condition changes, the dial can be quickly rotated so as to show the letter or figure representing the changed condition. Above the notch or gap in the tag is painted the engine number and the class letter or mark. Above the number and class letter is a little pocket formed when folding the tin which is used to hold small labels, either to represent the class of service of an engine in service, such as passenger (through or local); freight (through or local); pushing or helping, shifting, maintenance of way, extra or reserve, etc. In case of engine out of service in the shops, a small card label, as shown, is slipped into this pocket to show what division the engine was in service on before she was shopped.

The board in the office of the superintendent of motive power is 3 feet 7 inches deep and 6 feet wide, and gives the location, service and condition of all engines on the road. In the offices of the various master mechanics are smaller boards of similar design, giving records for their divisions only.

Notes.

The East River Bridge Commission last month received the formal approval of the bridge plans from the Secretary of War. They also entered into a contract with F. W. Miller for the borings necessary for the New York anchorages, the price being 40 cents per lineal foot.

A motor vehicle race took place last week between Paris and Marseilles and return. The distance is 1,051 miles and the first vehicle to arrive was the Michelin motor cycle, which made the trip in 72 hours, including all stops, or at the average rate of 14.6 miles per hour.

The Pennsylvania Railroad considers the outlook so good for business after election that it has ordered all idle freight cars to be put in readiness for use on short notice. In August the number of cars passing through the Harrisburg yards is given as 62,666; in September, 73,303, and October figures show a still greater increase.

The first of the three torpedo boats which the Columbian Iron Works, of Baltimore, is building for the United States government, was launched on October 1. This boat is 160 feet long on the water line, 16 feet beam, and 138 tons displacement. The engines are triple expansion and drive twin screws. Their horsepower is to be 2,000. The contract calls for a speed of 24½ knots.

One of the twin-screw steel ferryboats for use on the Pennsylvania Railroad's new Twenty-third street ferry across the Hudson was launched at Cramp's shipyard on Oct. 17. The boat is to be called the *Pittsburgh*, and a sister ship, being built by Charles Hillman & Co., Philadelphia, is to be called *St. Louis*. The boats have been described in these columns. The chief novelty about them is the use of twin screws at each end of the boat, or four screws in all.

The Pacific Coast may soon have a new and regular source of fuel supply. An American bark recently arrived at San Francisco with a sample cargo of coal from the Tonquin District of China. The coal beds are said to be extensive, and it is also claimed that with the cheap Chinese labor available and the present tariff rates, the coal can successfully compete with the other fuels in the market on the Pacific Coast, providing the quality of the coal is satisfactory.

In a paper before the British Association Mr. E. W. Anderson relates his experience for eight years with an electric traveling crane and a steam traveling crane working side by side in a foundry. The electric crane has one motor, geared to furnish power for all three motions required, and is of 20 tons capacity. When first installed there was a prejudice against it, but now it is the favorite with the men. The repairs to the electric crane have cost less than in the case of the steam crane and in many ways the former has proved more convenient.

The great engineering work of removing the obstruction in the Danube River, known as the Iron Gates, between Alt-Orsova in Hungary and Gladova, in Servia, has been accomplished and the river opened to navigation Sept. 27. The passage of the Iron Gates has always been dangerous and much of the time wholly impracticable to vessels drawing 5 feet of water, because of the rocks and the rapids they created. Enormous quantities of rock have been removed and the river thus made navigable for the largest river steamers from Vienna to the Black Sea. It is said that the work cost nearly $10,000,000.

The Steam Engineering Class of the Young Men's Institute, 222-224 Bowery, New York City, opened its 1896-97 session on the evening of Oct. 7, 1896, and will continue open Wednesday and Friday evenings until April 29, 1897. The class is in charge of Mr. Wm. H. Weightman as usual. Its object is the instruction of all employed or expecting to be employed in the practical operations of engines, boilers and machinery, and desirous of gaining a knowledge of or improving themselves in the theoretical branches, rules and practice of steam engine, boiler and power transmission calculations. Those desiring to avail themselves of the opportunity should join the class at once.

In the *Engineer* for Oct. 9, Mr. Chas. Rous-Marten gives some facts about the longest regular run without stops in the world. This run is made daily on the Great Western Railroad of England, between Paddington and Exeter, and is 194 miles long. The average speed according to schedule is 51.7 miles per hour. The train usually consists of six cars carried on trucks, and weighing 140 long tons behind the engine. The engine hauling the train is a 19 by 24 with one pair of drivers 7 feet 8 inches in diameter, and

a four-wheeled leading truck. The steam pressure is 160 pounds, and the heating surface 1,561 square feet. The grades are easy and the road favorable to fast running, but at Bristol the train passes around a loop to avoid the station and the curves in the track at this point compel the speed to be kept down to about 10 miles per hour. There is also one grade of 1 in 81.

The lens for the great telescope of the new observatory at Lake Geneva, Wis., has been completed after two and a half years' labor, and now lies at the workshop of Prof. Alvin Clark, in Cambridge, awaiting the orders of the Chicago University authorities. Its focal distance is 61 feet; the extreme diameter of the clear aperature is 41⅛ inches. The crown is about 3 inches thick at the middle, and 1¼ inches thick at the outer edges, and weighs 205 pounds. The flint weighs 310 pounds. The lens and its iron ring and cell weigh about 1,000 pounds. The cost of the glass plates, in Paris, was $40,000, and the entire cost of the lens is estimated to have been $100,000. For its journey West it will be wrapped in flannel and bedded in curled hair in a box mounted on springs and packed with excelsior in a larger box. It will ride in the center of a parlor car, and will be accompanied by four men.

Last November one of four vertical triple-expansion Corliss engines, built by Fraser & Chalmers, Limited, of Chicago, for the De Beers Consolidated mines, Kimberly, was tested to see if it met the guarantee of the builders that the dry steam consumed per brake horse-power should not exceed 145 pounds. The engines were each of 225 horse-power. The cylinders are 11½ inches, 19 inches and 30 inches in diameter by 36 inches stroke. The engine has two cranks 90 degrees apart. The cylinders are jacketed. The steam pressure during the test averaged 123.7 pounds above the atmosphere, the vacuum 11.5 pounds. The engine made 74.6 revolutions per minute, and developed 223.86 brake horse-power and 234.32 indicated horse-power. The frictional horse-power was thus only 4.4 per cent. The dry steam per brake horse-power was only 13.5 pounds, and per indicated horse-power, 12.9 pounds, a truly notable result. The test lasted five hours.

A notable steam yacht has been designed by Mr. Charles D. Mosher, and is now under construction at Upper Nyack for Mr. Charles R. Flint, of New York City. The boat is to have a guaranteed speed of 33 knots, or about 38 miles per hour. It will be 122 feet long, 12½ feet beam and 4 feet draft. It will be driven by twin screws and quadruple-expansion engines of 2,000 horse-power. There will be independent air, feed and circulating pumps, electric-lighting plant, and blowers for forced draft. Steam will be supplied by two Mosher water-tube boilers. The hull of the boat will be divided into seven compartments by water-tight bulkheads. The coal bunkers will be of large capacity. The fittings of the boat will be excellent, but the most interesting feature is the facility with which all the upper works can be removed and replaced with a turtle-back deck and two conning towers. Simultaneously with this change the boat can be fitted with torpedoes and rapid-firing guns, thus converting the yacht into one of the fastest and most effective of torpedo. boats.

The last session of the Mexican Congress amended the existing patent law of that country, so that article 33 reads as follows: "The owner of a patent is obliged to prove to the Department of Encouragement at the end of each period of five years of the life of the patent that, with a view of maintaining it for another five years, he has paid into the general Treasury of the Federation the sum of $50 at the close of the first five years, or $75 at the expiration of ten years, and $100 at the expiration of fifteen years. All these payments have to be made in Mexican dollars. The term within which these payments have to be proved shall be two months after the conclusion of each period of five years. This term cannot be extended. Persons who up to the promulgation of this law shall have lost their patents under Section 3, Article 37 of the law of June 7, 1890, may avail themselves of the benefits of this law to save their patents, provided they pay the proper fees within three months of such promulgation. But the patent thus revived is without prejudice to the rights acquired by other parties subsequently to the declaration of forfeiture."

The Joint Select Committee, created at the last session of Congress, to investigate and report upon the question of the use of alcohol free of tax in the manufactures and arts, have prepared a series of interrogatories, which will be distributed throughout the country to such parties as are thought to be interested in the question. It is the earnest desire of the committee to secure all possible information bearing upon the subject, and it is hoped that parties interested will submit their views to the committee promptly. Sets of the circular letter and blank for replies will be supplied to any applicant by addressing the Chairman, Room 21, Senate Annex, Washington, D. C. The commitee, which is composed of three members of each House, will probably assemble in Washington soon after the middle of November for the purpose of formulating a report to Congress accompanied by the draft of a law which will place domestic industries on as favorable a basis as similar industries in foreign countries. During their sessions in Washington hearings will probably be given in order to supplement the information obtained through the interrogatories sent out by mail.

The New York *Tribune* says that the United States Naval authorities have tested and found highly satisfactory an improved Howell torpedo. The new torpedo is larger than any of that type previously tried, some of its dimensions being as follows: Extreme length, 14 feet 6 inches; greatest diameter, 17 inches; net weight of guncotton in charge, 174 pounds; net weight of water-wetting charge, 43.6 pounds; net weight of dry guncotton in primer, 2.35 pounds; immersed displacement in sea water, 1,150 pounds; launching weight of torpedo, 1,130 pounds; reserve buoyancy, 20 pounds; mean speed over range of 400 yards, 33 knots; over 600 yards, 30 knots; over 800 yards, 28.5 knots. The extreme effective range, as adjusted for regular service, is 1,000 yards; the deflection from beam fire at a ship with a speed of 17 knots, 5 degrees; weight of fly-wheel, 30 pounds; most efficient fly-wheel speed at start, 9,600 revolutions per minute; pitch of screw at start, 14 inches; pitch of screw at finish, 29 inches; diameter of screws, 10 inches. The total displacement weight of a center pivot launching tube is 2,203 pounds; that of the tube proper, 1,153 pounds; of a carriage, 422 pounds; of a racer, 98 pounds; of the motor, 330 pounds; of the piping to swivel, 200 pounds. The weight of a powder blast in the cartridge case is six ounces.

The North Atlantic squadron passed through the heavy gale of last month when on its way from Hampton Roads to New York. Most of the ships behaved well in the storm, but the crew of the battle-ship *Indiana* had an experience they will not soon forget. Captain Evans gave an account of it, from which we take the following: "Soon after we left Hampton Roads Monday all four of the 8-inch turrets broke loose at once from their gearing. That was about 2 o'clock in the afternoon. We went to work with 5-inch hawsers to tie the guns up. We tied the two forward turrets together by binding the guns each to the other and fastening the hawsers to the bits, and managed the aft ones the same way. It was a very hard job. About 2 o'clock the next morning the forward ones snapped their hawsers and got loose again. The storm was then very severe, and the ship was rolling at an angle of 36 degrees. The decks were flooded with water, and this, with the pitching of the ship, made working on deck very dangerous. To make matters worse, the forward 13-inch gun turret got loose, and those enormous guns began thrashing about in full command of the deck. We fastened a 5-inch hawser on the 13-inch gun and it snapped like a cotton string. We finally caught the big guns with an 8-inch hawser and tied them securely to the superstructure. It was an awful job, though, and we were in danger of being washed overboard every minute. All during the work the deck was completely flooded."

A series of interesting tests were recently made on short sections of wire cable in the laboratory of the Yorkshire College, Leeds, England, and described in *Engineering*. In making the

tests it was found that none of the cappings supplied by the makers was at all satisfactory; most of them gave way at about one-half the breaking load of the rope, when taking the strength of the rope as the sum of the strength of the wires tested individually. After several experiments it was found that the only really satisfactory method of making the strength of the cap approximately equal to the strength of the rope is as follows: Before cutting off a sample length from the bulk of the rope, it is tightly bound with wire at about six inches from the end, and then cut off. The specimen is then tightly served with tarred band from end to end, in order to keep the strands in their proper position. The ends are then frayed out, and the end of each wire turned over; each end of the rope is then put in boiling caustic soda to remove tar and grease, thoroughly washed in hot water, then dipped in "killed spirits"—i. e., chloride of zinc, and afterward in molten solder; each wire then gets tinned. The ends are then put into split conical dies, and an alloy, consisting of lead, tin and antimony, is cast round it, which completes the capping process. The rope is then pulled apart in the testing machine, the ends being held in conical dies. The results of seven tests show that the breaking strains of from 12,960 pounds to 55,500 pounds for the different ropes were all from 93.4 to 96.2 per cent. of the sum of the strengths of its component wires.

Consul Merritt, of Barmen, describes Herr Linde's process for the manufacture of liquid air, whereby also oxygen gas is obtained at a cheaper cost than that produced by the methods now in use. A powerful engine compresses air, which is cooled, as far as possible, by ordinary refrigerating methods and passed into a spirally coiled pipe a hundred yards long. This pipe is enclosed in a second spiral. By means of a throttle valve at the end of the inner spiral, a certain proportion of the compressed air is allowed to expand in the space between it and the outer pipe. Thus the stream of compressed air from the pump is cooled by that portion which has been allowed to expand, and arrives at the throttle valve in a colder state than the portion that preceded it. Consequently, it reaches a still lower temperature on expansion, cooling yet more powerfully the advancing stream in the inner tube. By carrying this cumulative cooling effect sufficiently far, the circulating air is at least brought down to its critica point and liquefies, after which a continuous stream of liquid air is merely a question of engine power. The cycle of operations can be readily apprehended; there is compression, expansion in a closed chamber, and utilization of the cold thus produced to repeat the cycle from a lower initial temperature. The apparatus produces with the greatest ease a substance for which there is already a large industrial demand—oxygen gas. During the process just described, the air becomes steadily richer in oxygen until that gas forms some 70 per cent. of the product. This relatively pure oxygen is sufficiently good for certain purposes, and it may be further purified from nitrogen if desired.

The trouble encountered again during the past season with the Belleville water-tube boilers in the Northern line passenger steamers *North Land* and *North West*, especially the latter boat, has been the subject of a great deal of comment among engineers on the lakes, and rumors have been circulated about new boilers being adopted. Builders of the steamers have disclaimed any responsibility for difficulty with the boilers, as they hold that they opposed the adoption of them at the outset. Mr. Miers Coryell, who represented the French owners of patent rights on the boilers, and who, even up to the close of the passenger season this year, has been trying to straighten out the trouble, claims that the unsatisfactory operation of the ships has been due entirely to negligence in the management of the fire rooms. He writes from New York at considerable length on the subject, and in part says: "Among some of the practices which prevailed, and which the engineers estimated they could not prevent, were the following: Heavy fires, brought on by charging the furnaces with lumps of coal that were limited in size only by the dimensions of the furnace doors; ash pans full of dirt and clinker; furnace doors wide open half the time; damper doors kept wide open; boilers too full at times and again allowed to run scant of water, thereby damaging them; fireroom force cleaning a number of furnaces at a time, and in fact, conducting work of this kind at their leisure, allowing the steam pressure to drop as much as 100 pounds; then further delay by fires too thick to allow a passage of air through them, and a consequent discharge of clouds of black smoke instead of kindling fires in the furnaces. Then, too, the discharge pumps for disposal of ashes were run without a mixture of water with the cinder, which was equivalent to rotating them in emery. It would seem that they were purposely rendered useless, in a spirit of destruction and wickedness. As a result of this the boats would reach port with firerooms 18 inches deep with ashes.' —*Marine Review.*

Personals.

Mr. E. L. Langford has been chosen President of the Brooklyn & Brighton Beach, to succeed James Jourdan.

Mr. G. H. Clark, Jr., has been elected Vice-President of the Northampton & Hertford Railroad, with office at Newark, N. J.

G. M. Stewart, previously Acting General Manager of the Interoceanic Railway of Mexico, has been appointed General Manager.

Mr. Henry Kistner has been appointed General Foreman of Motive Power and Car Departments of the Monterey & Mexican Gulf.

Mr. H. L. Hawkins has been appointed Chief Engineer of the Oregon Improvement Company, with headquarters at Seattle, Wash.

Frederick A. Lex, formerly with A. Whitney & Sons, has become identified with the Lobdell Car Wheel Company of Wilmington, Del.

Mr. F. G. Patterson, President and Superintendent of the Altoona, Clearfield & Northern, was last month appointed as Receiver of the road.

Mr. J. A. Atwood, heretofore Principal Assistant Engineer of the Pittsburgh & Lake Erie, has been appointed Chief Engineer in place of Mr. F. E. House.

Mr. W. W. Wentz, Jr., has been appointed Secretary and Purchasing Agent of the Louisville, Evansville & St. Louis, with headquarters at Louisville, Ky.

Mr. Horace G. Burt has resigned as General Manager of the Chicago, St. Paul, Minneapolis & Omaha, to become Third Vice-President of the Chicago & Northwestern.

Mr. Edwin Hawley, of New York, Vice-President of the Minneapolis & St. Louis, was on Oct. 6 chosen Vice-President of that road to succeed Mr. W. L. Bull, resigned.

Mr. H. Walter Webb, Third Vice-President of the New York Central, New York City, has been appointed Temporary Receiver of the Ogdensburg & Lake Champlain Railroad.

Mr. Frank J. Sarnan, Master Mechanic on the Manitou Beach Railroad, has been appointed Superintendent, succeeding Mr. George C. Mills. Mr. Charles Sarnan succeeds him to the position of Master Mechanic.

M. J. F. Sechler has resigned as Master Mechanic of the Louisville, Evansville & St. Louis at Princeton, Ind. Mr. F. C. Cleaver, formerly Master Mechanic of the Vandalia line at Terre Haute, Ind., has been appointed in his stead.

Mr. Charles E. Levy, President of the New Orleans & Western Railway, has resigned, owing to poor health. Mr. W. Mason Smith, the Vice-President, was chosen to fill the vacant position, and Mr. W. W. Pierce was elected Vice-President.

Mr. Henry Fink, one of the Receivers of the Norfolk & Western, has been chosen President of the reorganized company which took possession of the property October 1. Mr. F. J. Kimball,

heretofore President and Receiver, is Chairman of the Board of Directors.

Mr. W. H. Brehm has been appointed Master Mechanic of the Missouri, Kansas & Texas north of Denison, Tex., with headquarters at Parsons, Kan. Mr. John L. Wigton has been appointed Master Car Builder of the lines north of Denison, Tex., with headquarters at Sedalia, Mo.

Mr. W. H. Stark has resigned his position as Master Car Builder of the Wheeling & Lake Erie Railway Company to give his attention to railway supply matters. Mr. Stark has an interest in several valuable railway appliances patented by him, which will probably be on the market in the near future.

Gen. Horace Porter, who has been first Vice-President of Pullman's Palace Car Company for many years, has resigned that office owing to his election to the position of Chairman of the Board of the St. Louis & San Francisco. The former second Vice-President, Mr. T. H. Wickes, succeeds General Porter as first Vice-President.

Mr. J. M. Wallace, Superintendent of Motive Power of the Pennsylvania Railroad at Altoona, Pa., will succeed the late Mr. Neilson as General Superintendent of the Philadelphia & Erie and the Northern Central Railroad. Mr. Wallace will be succeeded as Superintendent of Motive Power by Mr. W. W. Atterbury, now at Fort Wayne.

Mr. E. W. Knapp, Master Mechanic of the Mexican National, at Acambaro, Mex., has been transferred to the City of Mexico, and Mr. R. Fitzsimmons, Acting Master Mechanic at the latter point, has been appointed Foreman of Engines at Saltillo. Mr. E. D. Stegall has been appointed Master Mechanic of the Mexican National at Acambaro, Mex.

The promotion of Mr. F. W. Brazier from the position of General Forman of Car Works to that of Assistant Superintendent of Machinery of the Illinois Central Railroad will please his many friends. Mr. Brazier came from the Fitchburg road to take charge of the plant of the Chicago, New York & Boston Refrierator Company at Elsdon, Ill. Later he accepted his recent position on the Illinois Central.

Mr. Walter A. Scott, General Superintendent of the Chicago, St. Paul, Minneapolis & Omaha, has been appointed General Manager of that road, with headquarters at St. Paul, Minn., to succeed Mr. H. G. Burt, and the office of General Superintendent has been abolished. Mr. Scott was formerly Master Mechanic for ten years and Assistant Superintendent of Motive Power and Machinery for two years on the Chicago & Northwestern.

Last month we were in error in stating that Mr. R. P. C. Sanderson had resigned the position of Division Superintendent of Motive Power on the Norfolk & Western Railroad. The office of the General Superintendent with the staff belonging to that department was abolished on the Norfolk & Western Railroad, and Mr. Sanderson's position as a staff officer of the general superintendency was abolished with the general superintendency, but the duties of that position are being performed by him much the same as before, but under the Superintendent of Motive Power's supervision instead of under the General Superintendent's.

Mr. Robert Neilson, General Superintendent of the Philadelphia & Erie and Northern Central roads of the Pennsylvania system, died very suddenly at his home in Williamsport, Oct. 12. Mr. Neilson was born in Ontario, Canada, Aug. 19, 1837. He graduated from Rensselaer Polytechnic Institute in 1863, and immediately entered the service of the Pennsylvania Railroad as rodman on the Philadelphia & Erie. In 1865 he became Resident Engineer of the middle division of that road. In 1870 he was promoted to the Superintendency of the Western Pennsylvania division, and in 1874 he was appointed to a similar position on the Elmira and Canandaigua division of the Northern Central. In 1881 he was made General Superintendent of the Philadelphia & Erie and of the Northern Central north of Harrisburg, and in 1884 his responsibilities were extended to embrace the entire Northern Central. The duties of this position he discharged with great ability until his death. He had been in the service of the Pennsylvania for over 30 years.

Equipment Notes.

The Green Bay & Western is asking bids on 150 box cars.

The Cudahy Packing Company is in the market for 50 refrigerator cars.

The Winona & Western Railroad has ordered two locomotives from the Dickson Locomotive Works.

The Lima Locomotive Works have an order for one Shay locomotive for the Morning Mining Company.

The Louisville & Nashville has given out a contract for 15 engines, and it is asking bids on 300 gondola cars.

The Keokuk & Western road has contracted with the Rogers Locomotive Works for three 10-wheel locomotives.

The Spokane Falls & Northern Railway has contracted for one six-wheel connected engine with the Baldwin Locomotive Works.

The Michigan-Peninsular Car Company, Detroit, have been given an order for building 1,000 freight cars for the Erie Railroad.

The Georgia railroad, it is reported, has placed an order for 100 freight cars with the Youngstown Car Manufacturing company.

The Portland Company, Portland, Me., has an order for five four-wheel connected engines from the Grand Trunk Railway of Canada.

The St. Charles Car Works have delivered to President E. H. R. Green, of the Texas Midland Railroad, the private car recently completed for him.

Wells & French have been given the contract for building 100 refrigerator cars for Swift & Co. The latter company are asking bids on 50 stock cars.

The Stone, Coal and Lumber Freight Line of Atlanta, Ga., has recently contracted with the Car Trust Investment Company of New York for 200 cars.

The Rock Island Railroad is building at its own shops two fast locomotives of the designs recently gotten up by Mr. Wilson, and which have proved so satisfactory.

The International Great Northern has built a number of drawing-room cars for service between St. Louis and Galveston. They have 12 sections, and are supplied with buffets.

It is again reported that the Butler & Pittsburgh will soon be in the market for much of its new equipment, but the report is denied, and it is said that no orders will be placed before spring.

Rotary Acceleration.

A correspondent of the *Practical Engineer*, in commenting on an editorial in that paper on "train resistance," has the following to say about rotary acceleration:

"You remark that there is the rotary acceleration of the wheels and axles, which has, we believe, been nearly always neglected, but which forms, nevertheless, a very important part of the whole resistance, prompts me to say that there is an equal and universal tendency to ignore the effect of rotary acceleration in our text-books on mechanics. How often de we not find the little carriage running down an inclined plane with an acceleration calculated with total disregard of the rotary acceleration of the wheels*! and without any hint that any such a connection to the calculation is needed.* One occasionally even finds in standard text-books a problem given, in which a body is expected to *roll* down an inclined plane in exactly the same time as it would slide down if there were no friction. I take the following exercise from a well-known elementary text-book: "Show that the velocity acquired by a body rolling down a smooth inclined plane is the same as that acquired by falling vertically through the height of the plane." It appears to me that such an exercise, found with others in good text-books, is in itself a proof that the difference between sliding and rolling is not sufficiently brought to the front by teachers of mechanics. It is assumed in these cases that a body rolling down an inclined plane or along a smooth surface, under the influence of any force, will be subject to the same acceleration as when sliding down the plane or along the surface under the same force, which, of course, is not true.

A very simple experiment serves to bring out forcibly the great

influence of rotary acceleration upon the velocity acquired by wheels of different types. If a table napkin ring (a turned one) and a common cotton reel of nearly equal weight and diameter be procured, and set to roll down a drawing board tilted to a good inclination, it will be found that the reel will reach the bottom much sooner than the ring, owing to the mass of the ring being concentrated so near its periphery compared with the reel, that a much larger proportion of the energy due to the fall has to be spent in giving the ring its rotary acceleration. Indeed, in the case of a ring indefinitely thin, just one-half the energy is required for rotary acceleration, and the other half for the movement of translation. And hence, if a wheel could be made with all its mass concentrated in the center, such a wheel would reach the bottom of an inclined plane by the time the indefinitely thin ring had got half way only.

European Boiler Practices.

Mr. R. S. Hale, M. E., has recently submitted a report to the Steam Users' Association, of 31 Milk street, Boston, Mass., giving the results of his investigation upon European boiler practices, Mr. Hale having visited England, Germany, France and Belgium for this purpose. From a summary of it by the *Engineering Record* we take the following:

Regarding the types of boiler in use in the year 1895, Mr. Hale found that in England 38 per cent. were Lancashire and similar types, 23.7 per cent. Cornish, 6.8 per cent. of the externally fired cylindrical type, while the boilers of the water-tube type were found to be 1.8 per cent. In France the percentage of Lancashire and Cornish boilers is exceedingly small, while the externally-fired cylindrical leads the list at 57.3 per cent. The externally-fired multi-tubular, which evidently corresponds with the American return horizontal tubular boiler, represents 13.4 per cent. of the boilers in France, while none was found in England. The percentage of water-tube boilers in France was 5.7. In Germany the Lancashire represents 35 per cent., the Cornish 15 per cent., the externally-fired cylindrical 14.8 per cent., externally-fired multi-tubular 5.8 per cent., the locomotive 17.3 per cent., water tube 4.6 per cent.

The Lancashire boiler which, as we previously mentioned, is found in England, is generally 30 feet long by 7 feet 6 inches in diameter. It has two internal flues about 3 feet in diameter and a grate in each of them generally 6 feet long. Galloway or cross-tubes, 6 inches in diameter, five to each flue, are often placed in the flues back of the bridge wall. The gases after passing through the flues pass underneath the boilers to the front and then back along the sides to an underground flue. Such a boiler would have 36 square feet of grate, and 1,000 square feet of heating surface. Mr. Hale said that when built for 160 pounds steam pressure, the boiler costs about $2,500 in England, and that it will easily deliver 6,000 pounds of steam per hour and more, although at this rate it is not very economical; but where used at a lower rate of combustion, or in conjunction with an economizer, it is as economical as any type of boiler. The boiler is easily cleaned and the outside is of easy access. The Cornish boiler is exactly like the Lancashire except that it has but one flue, placed in the center in England, while in Germany it is frequently placed to one side, with the idea of improving the circulation. The Galloway boiler is generally classed as a Lancashire, which it resembles in every respect except that the two furnaces meet back of the bridge wall in a single large flue filled with Galloway tubes.

Mr. Hale finds English workmanship fully equal to our best. In England, he states, no punching is allowed and the plates are always planed on the edges and then drilled in place. Steel is being used almost exclusively in England, while iron is still preferred in some places on the Continent. English makers usually figure on 20 years as the average life of a boiler.

Mr. Hale said that the internal flues in the Lancashire boiler are generally welded along the longitudinal seam, and the cross or Galloway tubes are frequently welded in. He did not hear of any case of welding a boiler shell itself. Mr. Hale stated that corrugated flues were made in various ways, and that while they were considered better in England, it was thought that most frequently the improvement did not warrant the expense. In comparing steam pressures it was found that for an American mill operating under 150 pounds pressure, the corresponding practice would be 200 pounds in England, 180 in Alsace and 150 in Belgium and Germany.

Economizers were much more general in Europe than in American practice. One economizer was generally put in for each battery of boilers, making the heating surface the same as the heating surface in the boiler. He noted that in some plants where economizers had been taken out the heating surface of the boilers had to do more than double to get the same economy. One advantage claimed for economizers and the Lancashire boilers was that the large amount of hot water in them offered a reserve of heat for a sudden call.

The use of superheated steam is very much in the air all over England, and in Alsace it is fairly general, about 500 superheaters being in use. There never has been any doubt that they save from 10 to 20 per cent. of coal, but the difficulty has been, Mr. Hale said, in the lubrication of the engine cylinder and in keeping the joints of the superheater tight.

Regarding grates, the practice in Germany in the case of under-fired boilers was to incline the grates downward to the rear as much as 18 inches, as it was thought to be easier for the firemen and to give better combustion.

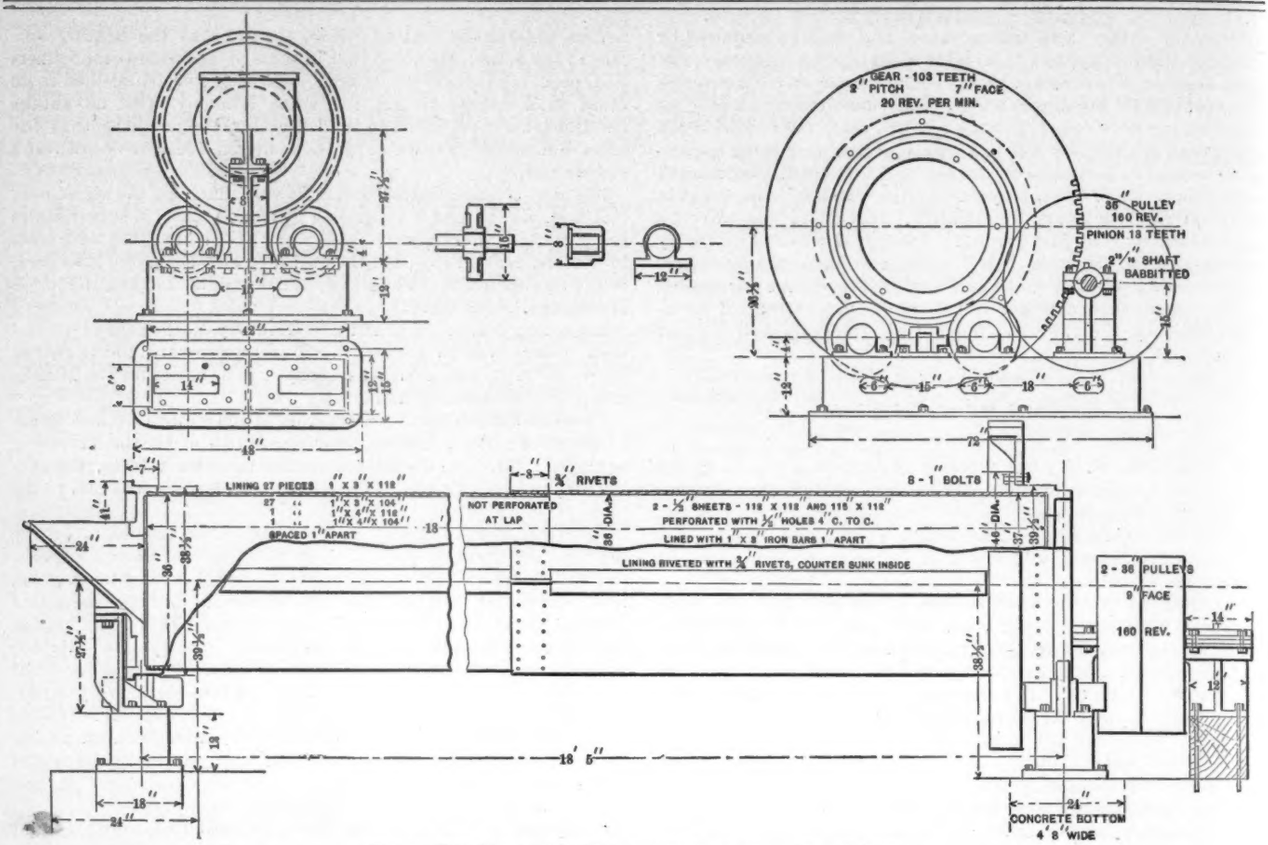
The report states that several forms of economical stokers were in use in England, perhaps over one-fourth of the boilers being equipped. Mr. Hale divides the stokers into two classes, the coking and sprinkling stokers, the former type feeding the coal to the front, where it cokes and is then carried to the rear by the reciprocating motion of the gratebars. The sprinkling stokers throw the coal over the grate by means of revolving or oscillating shovels. Mr. Hale found stokers of the former type to be the best known. It is believed in England that no stoker absolutely prevented smoke, but that both types very largely diminished it, the coking stoker having the advantage in this respect. The opinion is divided as to the economy of stokers. The most general reason for their adoption was the diminution of smoke, the laws being very strict. They also permit of the use of a cheaper fuel, but Mr. Hale is inclined to believe that the net saving in this direction after paying the interest and repairs amounted to little or nothing. The use of stokers and coal-handling appliances together was thought to save about one-third of the boiler-room labor in large plants.

In Germany grinding the coal to a powder and blowing this dust coal mixed with air into a hot combustion chamber was a method that was being experimented upon in several plants and was meeting with considerable favor. The fine dust, however, was not only very dirty to handle, but exceedingly liable to spontaneous combustion, and the problem of grinding and storing it had not as yet been commercially solved.

Boiler fittings abroad were noticeably heavier and stronger than in America and the use of a spring-loaded safety valve was looked upon with distrust. The average quality of the boiler and pipe coverings did not impress Mr. Hale as favorably as those in America. He had seen wood and even rope covering on high-pressure piping. In this respect Mr. Hale also calls attention to the wise practice of covering the top of boilers with a thick cheap covering to prevent the radiation of heat, this being generally done abroad.

In speaking of boiler operation Mr. Hale found that the surfaces of boilers were kept in a cleaner condition abroad than in this country. In some places they run the boiler until the specific gravity of the water is 1.005 and then they blow out and clean the boiler. In England they use soda, lime and potash in the boilers according to the impurities. In mills the fires are banked at night, while in electric stations the custom was very general to let the fires go out when they were not needed. Mr. Hale ascribed this difference not to the fact that a mill fire is out of use for a less time (14 hours) than an electric station fire (16 hours), but to the fact that in the case of a mill the new fire must be started at, say, 4 a. m., when it would involve an extra shift of men, whereas in electric stations the fire is needed at about 4 p. m. and involves no extra labor. From data given by several plants it was found that the cost of banking fires was about 40 pounds of coal per day per square foot of grate. The wages of the firemen are about $1.10 per day in England, 80 cents in France and Belgium, and 87 cents in Germany.

In boiler economy he could not see that they were either ahead or behind us; they get from 60 to 80 per cent. of the heat in the coal according to the air supply and evaporation per square foot of heating surface. None of their engineers had ever found any conbustible gases in the chimney except occasionally a little CO (carbonic oxide). Most of their tests, however, left some zero to 15 per cent. of the heat unaccounted for, which may be radiation or error. Some said one, some the other. No one had experimented as to why it is harder to supply the right amount of air to one kind of coal than to another, though they had all gone as far as to realize the immense importance of the air supply as compared with any


GEAR - 103 TEETH
2" PITCH 7" FACE
20 REV. PER MIN.
36" PULLEY
160 REV.
PINION 13 TEETH
2 11/16" SHAFT
BABBITTED
LINING 27 PIECES 1" X 3" X 112"
27 " 1" X 3" X 104"
1 " 1" X 4" X 116"
1 " 1" X 4" X 104"
SPACED 1" APART
NOT PERFORATED AT LAP
3/4" RIVETS
8 - 1" BOLTS
2 - 1/2" SHEETS - 112" X 112" AND 112" X 112"
PERFORATED WITH 1/2" HOLES 4" C. TO C.
LINED WITH 1" X 3" IRON BARS 1" APART
LINING RIVETED WITH 3/4" RIVETS, COUNTER SUNK INSIDE
2 - 36" PULLEYS
9" FACE
160 REV.
18' 5"
CONCRETE BOTTOM
4' 8" WIDE

Scrap Rattler at the Schenectady Locomotive Works.

other factor in boiler economy, and also to realize and to experiment on the amount of air that leaks through the settings of some types of boilers to the injury of the economy. Frequently more air has been found to leak through the settings than came through the fire. In some plants on the Continent they were painting the brick settings with a heavy tar paint to make them air-tight, and occasionally even inclosing them in sheet-iron casings. In Germany they have an instrument called the gas-balance which shows the per cent. of CO_2 (carbonic dioxide) in the flue gases on a dial like a steam gage. If not too delicate it promises to be of great practical use.

The special instruments used for boiler testing were the ordinary thermometer for low flue temperatures, and for high temperatures the electric resistance pyrometer, in England; the thermo-electric pyrometer used in Germany, and the mercury thermometer with compressed nitrogen or carbonic acid over the mercury, reading to 550 degrees Cent. (about 1,000 degrees Fahr. English measure). For analyzing flue gases the Orsat apparatus is most commonly used.

A Scrap "Rattler."

At the Schenectady Locomotive Works a great deal of scrap is worked up into forgings for the parts of locomotives. It was found that much better forgings could be made if the scrap was clean, that is, free from rust, scale and other impurities. In order to clean the scrap they have erected a rattler, shown by the engravings herewith. This consists of a wrought-iron cylinder 36 inches in diameter and 18 feet long, which is mounted on two pairs of friction rollers clearly shown in the end views. The drum is revolved by suitable gearing at one end, driven by a belt and pulleys. The scrap is fed into the drum at one end by a sort of hopper, and has a downward inclination from that end to the other, so that as it revolves the scrap is moved slowly from the mouth, as it may be called, toward the opposite end, where it is delivered freed from its impurities.

Some of our readers will remember Mr. Outerbridge's experiments, which showed that iron was increased in strength by rattling. Whether the forgings made of rattled scrap are stronger than those made from iron not treated in this way is probably not known.

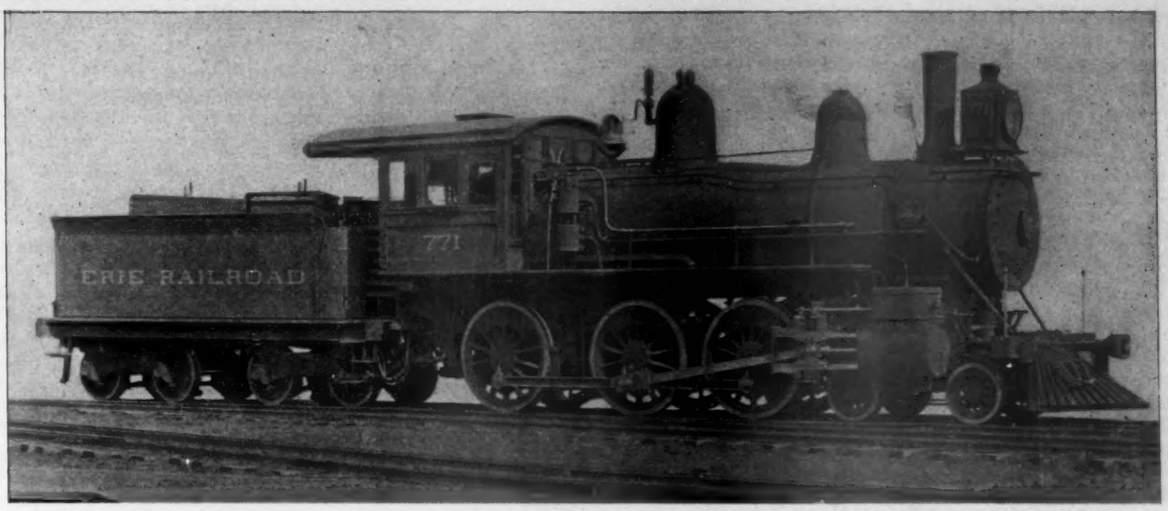
The Aylmer Branch of the Canadian Pacific Railway Operated by Electricity.

The latest development in Canadian electric railway work is the equipping of the Aylmer branch of the Canadian Pacific Railway with electric service. This line extends from Hull, a suburb of Ottawa, to Aylmer, where it connects with the Pontiac Pacific Junction Railway, extending 60 or 70 miles up the north side of the Ottawa River. The section from Hull to Aylmer has been leased by the Hull Electric Company for a period of 35 years, the understanding being that, besides passenger and mail traffic, they are to handle all through and local freight delivered to them by either the Canadian Pacific Railway or the Pontiac Pacific Junction Railway. As they are the only connecting link with the Pontiac Pacific Junction road, it can readily be understood that the quantity of freight is considerable, amounting usually to 50 or 75 cars per day. This freight is mostly handled at night, leaving the road free during the day for passenger traffic.

At the Aylmer end of the line the company owns 60 acres situated on Deschesne Lake, a sheet of water 3 miles wide by 27 miles long; an ideal spot for sailing and boating, thus forming a strong attraction for the Ottawa citizens. Indeed, the traffic has been far beyond expectations, and the train service had to be increased, until they are now running 36 regular trains each way per day, besides special excursion trains.

The power is obtained from Deschesne Rapids, where the lake of the same name empties itself into the Ottawa River, at a point midway between the termini of the road. The turbine wheels are of the "New American" type, manufactured by William Kennedy & Sons, of Owen Sound, Ontario, and operated under a head of nine feet. Four 60-inch wheels are now installed and space is provided for two more.

The electrical equipment of the power-house consists of two M. P. 4-200-425 generators, built by the Canadian General Electric Company. For controlling the output of these machines there is a switchboard, consisting of two generator panels, two feeder panels and a total output panel, all of the General Electric standard type and supplied by the Canadian Company. Besides these, there are three panels containing the "Barbour" water-wheel regulator, by which the current output of the generators is automatically kept constant by cutting in or out dead resistance as the load varies on the line. By this means the speed of the machines is kept con-



Ten-Wheel Passenger Locomotive for the Erie Railroad.—Built by the Brooks Locomotive Works.

stant and the variation in voltage is held within a very close limit. The car sheds and repair shops are also at Deschesne and are fully equipped with all modern appliances for handling and inspecting the rolling stock which at present consists of five closed cars and five open cars, besides a mail, baggage and express car and a locomotive. All the cars are mounted on two trucks each, and are each equipped with two G. E. 1,200 motors with K. 21 controllers. The closed cars are 42 feet long over all, and finished in mahogany throughout, the outside sheeting being also solid mahogany finish, in the natural wood.

The locomotive is of particular interest, being the first of the kind operated in Canada. It weighs something over 20 tons and is provided with double trucks, each axle being equipped with a motor. As all the wheels are driven, full traction advantage is obtained from the total weight and a draw-bar pull of 10,000 pounds can therefore be expected.—*Electrical Engineer.*

Ten-Wheeled Passenger Engine for Erie Railroad.—Built by the Brooks Locomotive Works.

The engine shown herewith is one of five ten-wheeled passenger engines built for the Erie Railroad by the Brooks Locomotive Works. They have 20 by 26-inch cylinders, driving wheels 62 inches in diameter, a boiler 64 inches in diameter, firebox 107¼ by 40¼ inches, 282 flues 2 inches by 13 feet 2 inches, a driving-wheel base of 13 feet 6 inches, total engine-wheel base of 24 feet 2 inches, and weigh in working order 108,000 pounds on the drivers. The total weight of the engine is 144,750 pounds, and of the tender 87,000 pounds. The boiler pressure carried is 180 pounds. The boiler is of the radial-stay type. The firebox is of carbon steel, the stays of Taylor iron. The engine truck has a swing motion and is carried on Paige steel-tired wheels. Other fittings are United States metallic packing, American balanced valves, Magnus bearing metal, Metropolitan and Monitor injectors, one each, McDowell inside boiler checks, Fox pressed steel truck frames, Kewanee brake beams, Morris steel-box lids, French springs, Magnesia boiler covering, pressed steel cylinder-head casings and boiler front and door, Gould and Thurmond couplers, Kelly headlights, Westinghouse brakes, Gollman bell ringer, Ashcroft steam gage, Consolidated muffled pop valves, Detroit lubricators, and Midvale tires. The firebox rings are double rivetted. The main and side rods are of steel, with oil cups forged on, and all the axles are of hammered steel.

Cast-Iron vs. Steel-Tired Wheels.*

Recently this question was forced on the writer's attention by some articles and notices in the technical papers, which if believed in and followed up to their natural conclusion would lead one around to the steel-tired wheel makers' door for wheels for passenger cars, and necessitate the purchase and installation of wheel lathes at all the shops, increasing the first cost and maintenance cost of the passenger train considerably.

A search through the newspaper records of accidents for 1895 showed that there were just 22 cases of wrecks or derailments, freight and passenger, caused by broken wheels in the year, while there must have been something like 9,720,000 chilled iron wheels constantly in service under both passenger and freight cars during the year. The following is believed to be a fairly correct estimate of the number of accidents caused by broken wheels 1886 to 1894 inclusive:

1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.
37	27	48	28	37	39	46	48	33

While considering the question of relative safety, it is proper to mention that the steel-tired wheels are not the perfect panacea for the broken wheel problem. Reference to the M. C. B. reports on steel-tired wheels will show records of very considerable percentage of failures, and reference to the Board of Trade returns for the English railroads, and to the reports from the German Railway Union, show a considerable number of steel-tired wheel failures and some accidents from these, but the figures are not in such shape that comparisons can be made.

In a published report of some experiments made on the Pennsylvania Railroad, to ascertain the effect of heating the treads of chilled wheels,* it is stated that chilled wheels of various makes were placed in the sand and molten iron poured around the tread, when it was found that a large proportion of the wheels so tested cracked and broke, while the wheels made at the Altoona foundry would almost all stand this treatment without breaking. We can assume that wheels can be made at a reasonable cost that will stand such a test at other foundries as well as at Altoona, and can be bought at a small advance in price, if we insist on having them, and will pay for them. That a wheel in actual service will never be heated in such a manner as these test wheels were heated is reasonably certain. It is believed that leaving a red-hot brake shoe set against a standing wheel is very apt to cause cracked wheels, because severe strains would be set up in the plates and ribs due to the local heating.

Assuming that there are about 34,000 passenger equipment cars in constant service and that the numbers of wheels in service under these cars (four and six-wheel trucks) would approximate 306,000; that a first-class chilled 33-inch wheel weighs 600 pounds and that the average weight of the steel-tired 33-inch wheels (see M. C. B. report of 1895) is 802 pounds—some of them weigh over 1,000 pounds—this would mean that the difference in the weight of this many wheels alone, as between cast-iron and steel-tired wheels, would be 30,900 tons, which we would be burning coal to haul, at speeds up to and over 60 miles per hour, around the country.

Now, as regards the running qualities of steel-tired vs. chilled

*From a paper before the Southern and Southwestern Railroad Club by R. P. C. Sanderson.

* The results of these experiments were published in THE AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL for June, 1896, and have not appeared elsewhere, except as they have been copied from or have been suggested by our account.—EDITOR.

wheels, it is an indisputable fact that chilled wheels can be turned out equally true for much less cost. I have it on certain authority that it costs to grind a pair of new 33-inch wheels, mounted on the axle, for labor, 18 cents; emery wheel worn off, 3 cents; per pair, 21 cents. Regrinding old wheels on the axle, average for labor, 22 cents; emery wheel worn away, 6 cents; per pair, 28 cents. And these wheels, when ground, are just as true as any pair of steel-tired wheels ever turned out of a lathe.

Reference again to the report of the Committee on Brakeshoe Tests shows that the friction and loss of metal, where soft steel shoes were used on steel tires, was far greater than when soft steel shoes were used on cast-iron wheels. The inference is perfectly plain that on curves the rail wear from the flanges of steel-tired wheels will be greater than from chilled iron wheels, making a harder pulling train, and necessitating more frequent renewals of rails, which are expensive.

Having touched on the question of safety, weight, running qualities and rail wear, let us look at the very important question of first and final cost.

A really first-class chilled wheel, cast in contracting chills, can be produced from high-grade materials, including royalties, at a foundry cost of $4.60 each, or, say, at a selling price of $5 each. For a pair of such, $10; add for cost of grinding true, 21 cents; cost of wheels when mounted, exclusive of axle and cost of boring, $10.21 per pair.

We do not seem to be able to buy a really first-class article in the way of a steel-tired wheel for much under $50 each, although some that promise well are offered at (turned) $40 each; two such, $80. Difference in favor of the ground cast wheels, $69.79 per pair; for an eight-wheel car this is $279.16 per car; for a 12-wheel car, $418.74 per car.

A reputable firm of steel wheel makers guarantee their wheels (costing $50 each new) for 260,000 miles; the M. C. B. guarantee for chilled wheels under the same service is 60,000 miles.

The steel-tired wheels will average 3¼ turnings to make the 260,000 miles. First cost of a pair of steel-tired wheels, say $80; cost of 3¼ turnings, shop handling and machine work, $5.25; cost of 3¼ removals and replacements at 60 cents, $2.10; total, $87.35. Deduct value of scrap, say 1,108 pounds at $8 and $10 per ton of 2,240 pounds, $4.94; cost per pair of steel-tired wheels for 260,000 miles, $82.41, exclusive of interest account; 260,000 miles represents about eight years and eight months' average service.

Assuming from the above that we would need to use 4⅛ pair of chilled wheels to make 260,000 miles, we have cost of 4⅛ pair of chilled wheels ground, $43.91; cost of 4⅛ replacements at 60 cents, $2.60; total, $46.51. Value of scrap, say 3,020 pounds, at $10 per ton of 2,240 pounds, $22.41. Cost of chilled wheels to run 260,000 miles, $24.10, a difference in favor of the chilled wheels per pair at the end of 260,000 miles, say $58.31.

Assuming that there are, as before mentioned, 34,000 passenger equipment cars in constant service, and making allowance for the number of six-wheel trucks under a portion of them, the difference in the amount of money invested in the one item of first cost of wheels alone would amount to about $1,863,540; and this does not include the extra cost of stock wheels, machinery, etc.

Reviewing all the above arguments which, while not pretending to absolute accuracy in some respects, are as correct as necessary, it seems proper to draw the conclusion that a really first-class 600-pound 33-inch chilled wheel, ground true, costing perhaps 30 cents to 50 cents more than an average wheel, bought on rigid test and guarantee, especially marked and reserved for passenger service, is good enough for ordinary United States railroading.

It would be hard to find any more elegant examples of the printers' and engravers' arts than the souvenir numbers of the *Street Railway Review* and the *Street Railway Journal*, both issued last month on the occasion of the convention of the American Street Railway Association at St. Louis. And when we say that the reading matter is as interesting as the press-work is good, we can add nothing in way of praise.

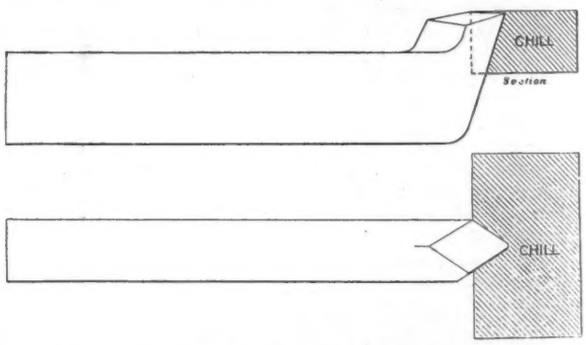
An important feature of *Harper's Magazine* for several months to come will be Poultney Bigelow's series of papers on the "White Man's Africa," treating in the author's original and striking way the new continent recently opened up to European exploitation. The first paper, in the November number, will give a novel view of Jameson's raid, from material placed in the author's hands by an English physician and a Boer official — thus presenting both sides of this remarkable episode. The series is the result of a journey to South Africa undertaken by Mr. Bigelow for *Harper's Magazine*, and is to be illustrated from photographs specially made for the purpose.

Cast-Iron Tools.

The illustrations and description of the cast-iron tools published in the October number appear to have interested so many persons that it is thought a description of the way they are made will not be out of place. They are cast from the ordinary wheel iron used in the Altoona foundry for making car wheels. The composition of this is from 30 to 35 per cent. of charcoal iron, 15 per cent. of coke iron, 5 per cent. of steel, and the balance old wheels made in the Altoona foundry. The coke iron is No. 2 foundry, and the specifications are that the silicon in it shall not exceed from 1 to 1.25 per cent.

The tools are cast from wooden or metal pattern, and of any form required. The chill or chill mold consists of a block of cast iron about one inch thick, and for a tool whose body is 1 by 1½ inches the chill is about 2 by 3 inches. This is notched out to the form of the point of the tool as shown in the illustration herewith, and is placed in the sand in the position in which it shown. The tools are cast with the point up, but the flasks are tipped up at the back end or heel of the tool so that the iron will be sure to fill out the point before it becomes cooled.

On inquiry, we found that these tools are not used in the wheel shops for turning axles nor for steel tires. One reason given is that they are liable to break under the set-screw, when fastened in the tool post. This difficulty may be overcome by putting a heavy piece of steel above or below the tool, before it is screwed



fast. One of the men using these tools informed the writer that he can do considerable more work with them for the reason that the work can be run at a higher speed, as they do not lose their temper or hardness by being heated, and that they can be heated red hot without being spoiled. There is no danger, either, of drawing the temper in grinding them on an emery wheel, as there is with steel tools. Surely, these are great advantages. They are, however, not suited for smooth-finishing cuts, as they will not hold a sharp cutting edge. As stated in our preceding article, they are used in lathes, planers and boring machines.

While in the toolroom, a cylindrical milling tool, 5 inches in diameter by 9 inch s long, was shown to the writer, which was made out of an old steel axle and case-hardened. It had done a very large amount of service and had been brought in to be reground or sharpened.

M. C. B. Lithographs and Standards.

Lithograph copies of the drawings of Standards (sheets M. C. B., 1 to 12, inclusive) and Recommended Practice (sheets M. C. B., A to E, inclusive), illustrated on a reduced scale by 17 sheets in the back of the Report of Proceedings for 1896, may be had on a similar number of sheets, 30 by 38 inches, by applying to the Secretary at 974 Rookery Building, Chicago, Ill. Blue-prints can be taken from these sheets. The sheets will be sold at 25 cents each, plus postage when sent by mail. If needed for blue-printing, they should be shipped by express, and orders should specify by what express company they should be shipped.

Blue-print copies, 30 by 38 inches, of the drawings of Recommended Practice (see plates C, D, E, F and G in back of Proceedings for 1896), regarding axle and journal-box and contained parts for cars of 80,000 pounds capacity, may be had by applying to the Secretary, same address as above. These blue-prints will be sold at cost, which we now estimate will be about 30 cents each.

Pamphlets containing the text of the Standards and Recommended Practice, same as printed in the Proceedings of 1896, will be furnished similarly at 25 cents each.

Rulings of the Arbitration Committee.

When the Rules of Interchange were revised in June, 1896, the Arbitration Committee was authorized by motion to make a ruling on questions arising and not settled by the Rules, which ruling should stand thereafter as part of the Rules for the year. The following subjects which have been brought to the attention of the committee at its meeting, Sept. 16, by numerous parties, have been considered worthy of such ruling:

A. Because of the postal authorities becoming more strict in regard to the railway service mail, it has been suggested to the Arbitration Committee that the repair card stubs, referred to in Section 16 of Rule 4, might be allowed to accompany the bills instead of being forwarded to the car owner on or before the twentieth day of each month. The Arbitration Committee sees no objection to the suggestion being followed unless some car owner insists that Section 16, Rule 4, be literally complied with.

B. Section 25 of Rule 5 is intended to protect car owners from loss by reason of damage done in switching cars, therefore switching roads are not allowed to render any bills for damage caused while cars are in their possession. It is not intended to prevent switching roads from rendering bills against their immediate connections for any repairs of owner's defects which may be authorized by such connections when delivering the cars, and which existed upon the cars at the time of delivery. In such cases the delivering road must pay the bills of the switching road, and can only recover from car owners by certification on bills rendered by delivering road against the owner, that these owner's defects existed before the cars were delivered to the switching road.

C. Under the head of defects of wheels, a portion of Section (d) of Rule 3 of the Rules for 1895, has been inadvertently omitted from the Rules for 1896, and the following should be considered as a part of Rule 3, under the head of "Owners Responsible":

"Worn flange; flanges having flat vertical surfaces extending more than one inch from tread."

D. No provision is made in the Rules of Interchange as to scrap credit for old brakeshoes removed, and no provision is made for labor charges in renewing brakeshoes. The Arbitration Committee, therefore, recommends that no credit be allowed for the scrap in such cases, and that no charge be made for the labor of renewing the shoes.

THE MOST ADVANTAGEOUS DIMENSIONS FOR LOCOMOTIVE EXHAUST PIPES AND SMOKESTACKS.*

BY INSPECTOR TROSKE.

(*Continued from Page* 27.3)

X.—Experiments with Different Shapes of Nozzles.

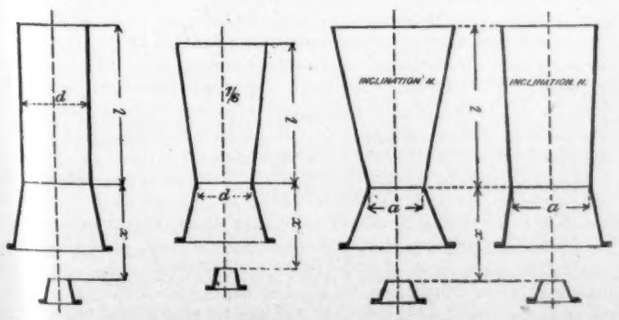
The experiments made with nozzles of the same opening, but of different inclinations and shapes, as shown in Fig. 68, gave no ground for thinking that the inclination of the conical sides of the nozzle or the overlapping form of the mouth exerts any noteworthy influence upon the action of the exhaust.

Prussmann's assertion, that the shape of the stack is dependent upon the inclination of the nozzle, here finds its refutation.

Conclusions.

The foregoing exposition and detail of experiments shows that

Fig. 69. Fig. 70. Fig. 71.



the action of a cylindrical stack upon the draft is dependent upon the inter-relationship of its size, that is to say, its free diameter d, its length l, and the distance x, from the nozzle (see Fig. 69), and also upon dlx.

If we change any one of these three dimensions in a stack the draft will also be changed. But by making a correlative change in the other two dimensions the new stack can be so designed that the same draft will be produced. Thus we can still retain a stack that will produce the same draft by making combinations with d, l and x.

The following cases are possible:

	Unchanged.	Changed.
1	d	lx
2	l	dx
3	x	dl
4	nothing	d, l, x

making four different forms.

In the conical stack as shown in Fig. 70, there must be added to the three preceeding dimensions a fourth, or the flare $\left(\frac{1}{n}\right)$ of that portion of the stack lying above the point of smallest cross-section, which thus makes the following combinations possible:

(1) Six combinations of twos;
(2) Four " " threes;
(3) One " " four;

thus making in all eleven forms.

The combinations of two are as follows:

	Unchanged.	Changed.
1	dn	lx
2	dl	nx
3	dx	ln
4	nl	dx
5	nx	dl
6	lx	dn

The two forms that correspond to the original and combination 6 are given as an example in Fig. 71.

The combinations of threes are as follows:

	Unchanged.	Changed.
1	d	nlx
2	n	dlx
3	l	dnx
4	x	dln

In the combination of fours the whole four elements must be changed.

Naturally, in place of the shape given in the groups others may be used, since for any single dimension different values may be assumed; for example, in the combination of twos the value for the flare in No. 6 may be $\frac{1}{6}$, $\frac{1}{4}$, $1\frac{1}{2}$, $\frac{1}{10}$, etc., corresponding to the diameter of the waist. The same course can be taken with the length l, the nozzle distance x, etc. We can see that a given vacuum can be obtained with a number of different shapes of stacks.

This is, consequently, not at In harmony with the opinion expressed by Clark (to be sure, it referred to cylindrical stacks only); that, "for a given locomotive there was but one form of stack in which the efficiency would be greatest, but in spite of the fact that Nozo and Geoffroy corroborated him and Zenner and Prussmann applied the same principle to conical stacks we are confirmed in the opinion that:

On any locomotive with a given diameter of nozzle the same height of vacuum can be maintained with different stacks; the form itself, whether cylindrical or conical, being a matter of no importance.

The stack which will give the best results from the standpoints of the blowing of the fire and the consumption of coal cannot be determined either theoretically or by experiments with the apparatus; and here actual service on the locomotives must step in and play its part. This alone can tell us what stack will cause the fire to burn most evenly and quietly and give the smallest production of cinders and sparks. In general, a large stack is to be preferred to a small one for the production of a given draft, since with it, as we have already shown, the sides of the smokebox and the tubes remain cleaner, and also because it appears to be less sensitive in its influence upon the draft for slight changes in the position of the nozzle than is the case with smaller stacks.

In order to show the relative equality of the conical and cylindrical stacks in reference to their influence upon the draft, as well as the necessary differences in diameter the accompanying Table XXVII., based upon the curves given in Plate I., has been drawn up. It comprises those stack diameters, which, with nozzle distances ranging from 18.9 inches to 26 inches and the five different nozzle diameters (3.94 inches to 5.51 inches), produce the same vacuum of from 3.35 inches to 3.94 inches of water with a pressure of 3.94 inches of mercury in the experimental apparatus.

* Paper read before the German Society of Mechanical Engineers, and published in *Glasers Annalen fur Gewerbe und Bauwesen*.

TABLE XXVII.

Vacuum in inches of water.	Nozzle distance and shape of stack.	Smallest diameter of stack in inches which, with the same nozzle distance on the experimental apparatus, will produce the vacuum indicated with a nozzle diameter of				
	Inches.	3.94 in.	4.33 in.	4.74 in.	5.12 in.	5.51 in.
3.35	18 90 — ¼	13.00	13.90	14.80	15.43	15.83
	18 90 — 1/12	14.53	15 36	16.26	16.73	17.13
	18 90 — cylindrical	15 98	17.01	17.99	18 50	18.90
3.51	20 47 — ¼	12 91	13.82	14.76	15.36	15.75
	20 47 — 1/12	14.33	15.20	16·06	16.58	16 97
	20 47 — cylindrical	15.51	16.58	17.60	18.07	16.47
3.74	22.05 — ¼	12 84	13.78	14.69	15 28	15.67
	22.05 — 1/12	14·10	15.10	15.91	16.42	16.81
	22.05 — cylindrical	14.92	16.10	17.13	17.64	17.95
3.94	23.62 — ¼	12.76	13.70	14.65	15.24	15.63
	23.62 — 1/12	13.86	14 76	15.75	16.26	16.65
	23.62 — cylindrical	14.21	15.55	16.69	17.20	17.48

From this we may obtain for example the equivalent stack diameter of 4.33 inches and a distance of 20.47 inches and find them to be:

For the cylindrical.....16.58 inches.
For the conical with ¼ flare.....13.82 inches.
For the conical with 1/12 flare.....15.20 inches

The table shows that the cylindrical stack for experiments on the apparatus, or the basis of this relationship, according to the nozzle distance required and the vacuum to be produced must, in this instance, be made 2.76 inches larger than the waist of a stack with ¼ flare and 1.38 inches larger than that with a flare of 1/12. Hence we conclude:

The less a stack opens out toward the top, by just so much more, for the same length, must its smallest diameter be made, if a draft of the same intensity is to be maintained.

If, therefore, it is desired to apply a stack to a locomotive that shall have the same effect upon the draft, but whose flare shall be different, while the length remains the same, the size of the diameter must vary and, inversely, if the diameter of the smallest section is to be left unchanged there must be a variation of the length.

For the sake of a practical demonstration a four-coupled eight-wheeled Erfurt express locomotive was tested with the same nozzle ratios and stacks of different diameters and flares as well as with cylindrical stacks of 15.75 inches and 18.7 inches in diameter. The length l was made to vary 23.62 inches and the diameter of the waist by 3.94 inches. They all steamed very well and permitted a heavily laden fast train to be hauled promptly on schedule time. The coal consumption and the production of sparks was naturally different. Accurate measurements showed that the cylindrical stack was large enough and yet it was no larger than the conical and was even smaller. Experiments were also made with cylindrical stacks on a locomotive of another make. Everything went to confirm the first results obtained on the apparatus, namely:

The conical stack is in no way superior to the cylindrical.

If Zenner and Grove arrive at a theoretical conclusion the opposite of this, it may be remarked that in their principal equation referring to it:

$$\frac{L}{D}\sqrt{\frac{\frac{fs}{fb}-c}{\mu\left(\frac{fs}{fr}\right)^2+c}}$$

the value of c, which expresses the conicity and shape of the stack, and is,

$$C=\frac{1+\left(\frac{fs}{fa}\right)^2}{2},$$

was an entirely mistaken one by them, owing to the lack of experimental data at that time.

In both of these equations:
L = the quantity of air, which is drawn in by
D = the quantity of steam blowing out of the nozzle.
fs = the smallest sectional area of the stack.
fa = " largest " " " " "
fb = " sectional area of the nozzle.
fr = " " " " " tube.
μ = a coefficient.

Both of these theoretical investigators now deduce from the foregoing formula:

The draft-producing efficiency of a stack increases as c becomes smaller; that is correct. But they also conclude c will be largest (fs remaining unchanged), for $fa = fs$, that is to say, for cylindrical stacks, and then $c = 1$; c will be smaller as fa increases, and it will be smallest ($= \frac{1}{2}$) for $fa = \infty$, that is to say for a stack the top of which has been widened out into infinity; from which it must be concluded that the more the stack widens out toward the top, by just that much will the effect upon the draft be more efficient. But this latter position is, as we have already shown, utterly untenable.

According to the Hanover experiments, as shown in Section VI., we find, on the contrary, the opposite to be the case, that is to say:

The smallest cross section of a stack remaining the same, the sharper a stack flares open toward the top (see Fig. 72) the less will be its effective action upon the draft.

Hence the foregoing equation:

$$C=\frac{1+\left(\frac{fs}{fa}\right)^2}{2}$$

should be understood as follows: It is not fs but rather fa that must remain unchanged. Then the smaller fs becomes relatively to fa, by just so much will C also become less, and the effective action upon the draft increased.

The smallest value of C corresponds to $fs = 0$, in whch $C = \frac{1}{2}$, in accordance with the reasonings of Zeuner and Grove; but it has merely a theoretical significance.

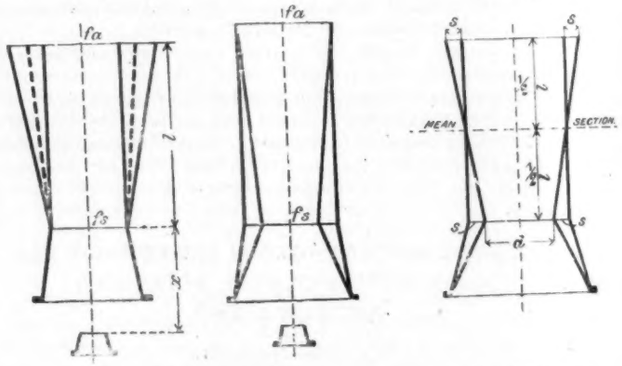
When $fs = fa$ (a cylindrical stack) the maximum value of $c = 1$ is that at which the smallest value is obtained for the vacuum.

When $fs < fa$ (a conical stack) the result is a lower value for c and a greater one for L.

This corresponds exactly with the results of the Hanover experiments (Section VI. *b*) which showed:

The upper diameter of a stack remaining thus unchanged, the sharper a stack contracts towards the bottom (see Fig. 73) by just so much, other conditions being the same, does the vacuum increase, in other words: *With the same diameter at the top the cylindrical stack is least effective as a draft producer.*

Fig. 72. Fig. 73. Fig. 74.



If the conical stack of Fig. 73 had the correct dimensions, the cylindrical stack of this figure for the same locomotive would naturally be too large, the nozzle relations remaining unchanged. If, on the other hand, the dimensions of the cylindrical stack were correct, then the conical stack that is indicated would be too small.

The above formula is therefore not available for making a comparison between conical and cylindrical stacks, and the many deductions made from it are unreliable. It simply asserts that generally a small stack produces a higher vacuum than a large one. The length of the stack and the position of the nozzle are not taken into consideration. Suppose a cylindrical stack with a sectional area fa (Fig. 73) produces too small a vacuum, the difficulty can be remedied without any change in the nozzle position, either by using a conical stack with a sectional area fa at the top, and whose smallest sectional area $fs < fa$, or by using a smaller cylindrical stack whose sectional area lies between fs and fa.

If it is desired to replace a cylindrical stack by a conical one, while the nozzle position and the draft is kept the same, it will be necessary, according to the experiments made on the four-coupled express locomotive, to keep the average sectional area of the two stacks the same; that is to say, we must make the upper diameter as much larger as the lower is contracted, as shown in Fig. 74. This, is, of course, on the supposition that the length above the base of the stack is to have a constant value l', which is the proper one for the sectional area of the tubes and the grate of the locomotive, and also with reference to d, as will be further explained later on.

As we have already explained, the experimental cylindrical stack

with a length of 3 feet 4.02 inches under fixed relations is 3.19 inches larger in diameter than the waist of the stack, having a flare of ⅓. This difference, according to the last table, becomes less the higher the vacuum; while, on the other hand, it increases as the nozzle distance is decreased, the height of the vacuum remaining the same.

Suppose we take, for example, a difference of 3.15 inches (80 millimeters), then, according to the comparison made below, with $l^1 = 3$ feet, 1.80 inch, the stack with a flare of one-sixth must be 3.15 inches, and that with one-eighth flare must be 2.36 inches smaller at the waist than a cylindrical stack of the same length l^1. Referring to figure 74, the size of s then becomes for

Stack with one-sixth flare = 1.575 inches.
" " one-eighth " = 1.18 "

In consequence of the foregoing equivalence of the cylindrical and conical stacks, the rule which has, up to this time, been accepted as correct, according to which a conical stack requires a larger blast-nozzle than a properly designed cylindrical stack, this rule, we say, has no longer any basis of support.

Both forms of stack, if properly designed, need the same diameter of nozzle for the production of the same draft.

Practical tests were made of this proposition on two standard express locomotives, with four wheels coupled, as well as on several compound and ordinary freight locomotives, and also on several tank locomotives, and in all cases the conical stack was replaced by the cylindrical without any contraction of the nozzle.

The steam production, the formation of sparks, the coal consumption, etc., was such, during a long run in actual service, that the drivers who were in charge were so well satisfied with the results that they never expressed a wish during the whole time to have the conical stack replaced.

XII. THE RULES OBTAINED.

The Grove rules* for the determination of the stack diameters depends entirely upon the sectional area of the tubes and ignores the grate area. This method of calculation was accurate for the locomotives of that time, but it is not applicable to the locomotives of to-day with their large grate areas. The stack diameters must rather be based upon both of these dimensions, as Clark has already pointed out in his time. As we well know, the ratio of heating surface to grate area varies considerably in practice.

Long boilers of the same or of similar construction frequently have different sizes of fireboxes, so that, in such cases with the same number and size of tubes, the grate areas may be of very different sizes. Hence, if it were allowable to settle the size of the stack with reference to the sectional area of the tubes only, locomotives, which might have widely different grate areas, would still have the same size of stack with the same nozzle opening. But this is practically unallowable, for it has been shown in locomotive service that large grate areas, under exactly the same conditions, need a lower vacuum and a larger stack than the smaller grate areas.†

The rules for the determination of the size of the stack must, therefore, take the grate area into consideration. *There are two ways in which this can be done:* Either we can calculate the diameter of the nozzle opening from the given sectional area of the tubes and the grate area, and then from this, by means of a corresponding ratio, determine the diameter of the stack, or we can calculate the latter directly from the grate area and the sectional area of the tubes, and then derive from it the proper diameter of the nozzle that is to be used. Both methods lead us to the same goal, but we prefer the latter.

For the sake of simplicity we show the method with which the grate area is taken into consideration and how a different value must be given to the co-efficient according to its size and which expresses the relationship existing between the sectional area of the stack and the tubes that must also be taken into account in the calculation. For example, suppose the grate area increase from 9.76 square feet (one square meter) to 26.9 square feet (2.5 square meters, this co-efficient, according to the experiments that have been made) rises from nearly .34 to .375 for conical stacks having a flare of one-sixth, while for cylindrical stacks it rises from .505 to .5625.

(To be continued.)

* The rule for hard coal firing is:
Sectional area of cylindrical stack = $.50fs$.
" " " waist of conical stack = $.33fs$.
Nozzle diameter for cylindrical stack = $\frac{1}{10}fs$.
" " " conical stack = $\frac{1}{12}fs$.
When fs indicate the seectional area of the tubes.
The flare of the conical stack equal $\frac{1}{6}$.

† A four-coupled compound locomotive of the Prussian State Railway, having a grate area of 24.4 square feet would, while hauling a heavy freight train weighing 183 gross tons at a speed of 50 miles per hour, maintain a vacuum of from 3.15 inches to 3.54 inches of water while cutting off at .43 of the stroke.

The Moskowitz System of Electric Car Lighting.

The National Electric Car Lighting Company, of New York, has a car on the Pennsylvania Railroad equipped with the Moskowitz system of car lighting, the patents on which are controlled by them, and is about to equip a chair car on the Santa Fe road for service between Chicago and Kansas City.

The system is an electric one in which the current is obtained from a dynamo driven from the axle. In the standard equipment of the company a 21-inch wooden split pulley is clamped onto the axle, and this is belted to a 7-inch pulley on a countershaft secured to the face of the truck transom. This countershaft is supported on "spring-cushioned" bearings, or bearings on which springs act in such a manner as to keep the belt tight when the journal boxes move up or down in the pedestals. From the countershaft another belt runs over an 8-inch pulley to a 4-inch pulley on the armature shaft of the dynamo, the latter being secured to the end piece of the truck frame. The split pulley is of specially prepared hard wood; the belts are double thickness, the one between the axle and countershaft being 6 inches wide and the other 3 inches, and both belts are specially prepared with a view of withstanding all sorts of weather, including snow and ice; the dynamo is encased in a steel cylinder that is dust and water proof, and all bearings are of durable metal and automatically oiled from cups or reservors that will hold a week's supply of lubricant. The dynamo weighs 300 pounds, the split pulley on the axle 35 pounds, and the countershaft complete 80 pounds.

The dynamo is so wound that it maintains a practically constant voltage at all speeds above eight miles per hour, there being an increase of only three volts between this speed and 60 miles per hour. The poles are automatically reversed with each reversal of the direction in which the car moves, this being accomplished by devices on the switchboard.

The dynamo does not generate electricity at speeds below eight miles per hour, and to keep the lights going at times when the car is standing or running slow, two sets of storage batteries are provided, one set charged and ready to be automatically thrown into the light circuit when the speed falls below eight miles per hour, and the other being charged by surplus current generated by the dynamo. When fully charged the second battery is switched into the light circuit and the first one is connected to the dynamo for recharging.

The standard equipment for a 60-foot passenger car consists of fouteen 16 candle-power lamps, twelve in the body of the car and one in each vestibule. The current is taken from the dynamos on the truck by flexible connections to the car body and thence to a switchboard located at any convenient point, preferably in one of the closets in the car. The board is boxed up and can be put under lock and key if desired. On the switchboard are grouped all the devices by which the entire apparatus is controlled. First, there is the main switch, which controls all the dynamo circuits and which must be closed in order that the dynamo may generate a current. An ammeter shows the quantity of current generated and a resistance coil is provided to be switched into the light circuit if needed. Then there are the automatic electro-magnetic devices for reversing the polarity in the dynamo, already mentioned. There is also a special 12-point switch which controls the whole system. It is connected with the two sets of storage batteries already mentioned. While one of these batteries is furnishing light the other is being charged from the dynamo. When the battery that is furnishing the light is exhausted, the switch is thrown to the opposite position, and thereby connects the battery that has just been charged with the lights, while the other is connected with the dynamo to be charged again. One turn of the switch accomplishes the two changes, and it is impossible to make a mistake.

The storage batteries are carried in two wooden boxes under the car, and it is claimed that they require looking after only once in several months.

It will thus be seen that the system comprises the dynamo, two sets of storage batteries, a light circuit, and a switchboard. A car is supposed to start after installation of the system with its batteries charged sufficiently for six hours' light, and should then have current at all times for lighting purposes.

The chief claims made for the system are: A high grade of efficiency at moderate first cost, simplicity of design, ease of inspection, small operating expense, and the possibility of employing unskilled labor for attendance. The simplicity of operation is evident when it is considered that there are but two switches to operate, one throwing the dynamo into or out of service, and the other changing the connections to the batteries. All other features are automatic.

The National Electric Car Lighting Company has offices at 30 Broad street, New York City.

New Publications.

THE CHICAGO MAIN DRAINAGE CHANNEL. A description of the Machinery Used and Methods of Work Adopted in excavating the the 28-mile Drainage Canal from Chicago to Lockport, Ill. By Chas. S. Hill, C. E., Associate Editor *Engineering News*. The Engineering News Publishing Company, New York, 1896. 129 pp., 8 inches by 11 inches.

The drainage canal which the city of Chicago is constructing is one of the greatest works of its kind in the world, and the policy of letting the excavation of the 40,000,000 cubic yards of earth and rock in small sections, combined with the variety of the materials to be excavated, has resulted in the employment of many methods for handling the material. Engineers expert in this kind of work have everywhere praised many of the methods devised and employed successfully by contractors who previously had little actual practice in canal work. Hence the volume before us is of special interest and value, for it describes and illustrates the methods and machinery employed. The cost of excavation are also given whenever obtainable, and while contractors would not in all cases furnish cost figures, the author believes that this volume contains more complete figures of the work than exist anywhere outside of the official records of the canal engineers. The book contains 100 excellent engravings and is written in a clear and concise style. It is a reprint of a series of articles which appeared in *Engineering News* last year, but numerous additions and revisions bring the work up to date. In an appendix the effect of the completed canal on the lake levels is fully discussed. We heartily commend the book to the attention of our readers.

LOCOMOTIVE MECHANISM AND ENGINEERING. With an Appendix on the modern electric locomotive. By H. C Reagan, Jr., Locomotive Engineer. Second edition. John Wiley & Sons, New York. Chapman & Hall, Limited, London. 1896. 419 pages. 5 inches by 7 inches.

This book undoubtedly contains information of value to locomotive engineers and firemen, but the style of the author is far from clear, and what he says, if taken literally, would sometimes be misleading and even absurd. For instance, on page 2 he says: "That portion of boiler which is over the firebox must be very strongly stayed with either crown bars or radial stays. . . . This staying is necessary from the large area and the exposure to the hottest part of the fire." Neither of these reasons is true. Certain parts of boilers are stayed because their shape or form is such as to require it. On page 5 is the following: "It is important that all gage-cocks should be kept open and especially, under all circumstances, the lower one." What the author evidently means is that gage-cocks should not be allowed to become clogged up, but he does not say so. On the contrary, he appears at first sight to advocate the practice of running an engine with the gage-cocks wide open. On the same page the explanation of why the use of wet steam should be avoided could be considerably improved in clearness and accuracy. We might quote many other cases of bad English, such as where the author calls pistons "round disks," etc., and of misstatements, such as where it is said on page 73 that "cushion" in a cylinder is required "to prevent the piston head from striking the cylinder head"; but it is not necessary to go through its 419 pages to indicate the character of the work. In general, it may be said that the author appears to have a good fund of practical knowledge, but he is not sufficiently grounded in the principles of locomotive engineering to be always accurate; and furthermore, that his command of language is not sufficient to enable him to say just what he means in all cases.

EXPERIMENTS UPON THE CONTRACTION OF THE LIQUID VEIN ISSUING FROM AN ORIFICE, AND UPON THE DISTRIBUTION OF VELOCITIES WITHIN IT. By H. Bazin, Inspector Général des Ponts et Chaussées. Translated by John C. Trautwine, Jr. John Wiley & Sons, New York; Chapman & Hall, Limited, London, 1896. 64 pages, 5¾ inches by 9 inches.

This book records the results of very accurate experiments made upon liquid veins by the author, at Dijon, beginning in 1890. The orifices were as follows; 1. Orifices in a vertical plane: Square orifice, 0.20 meter square (contraction complete); circular orifice, 0 20 meter in diameter (contraction complete); rectangular orifice, 0.80 meter wide by 0.20 meter high (lateral contraction suppressed). 2. Orifices in a horizontal plane: Circular orifice, 0.20 meter in diameter (contraction complete); circular orifice, 0.10 meter in diameter (contraction complete). The co-efficients of discharge, the geometrical figures of the veins and the velocities in the interiors of the veins, were determined for each of these orifices, under a head of 0.95 meters. Many valuable figures are given and the more important conclusions may be briefly stated as follows: The experiments do not show the presence of a minimum section in the contracted vein. The vein contracts rapidly at first and then more slowly as its distance from the orifice increases. The minimum velocity at the orifice is at the center for orifices in a horizontal plane and a little above the center of gravity of the section for orifices in vertical planes. As the distance from the orifice increases the velocities in the flow from a horizontal circular orifice equalize rapidly; in the flow from a vertical orifice the minimum in the central region soon disappears, but the velocities in the lower part of the vein remain greater than those in the upper part. In the expression $U = K\sqrt{2g(h + y)}$, U representing the velocity and y the fall of the center of the section below that of the orifice, the co-efficient K is slightly less than unity for a horizontal orifice and more than unity for a vertical one. It might attain a value of 1.03 or 1.04 for vertical orifices.

The volume is a most valuable addition to the literature of hydraulics, and the reputation of the author is a guarantee of the accuracy of the work, for his name is already known to English-speaking engineers through his valuable experiments on the flow of water in open channels.

Trade Catalogues.

[In 1894 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car-Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

LIST OF GEARING, PULLEYS, SHEAVES, ETC. Robert Poole & Son Company, Engineers and Founders, Baltimore. Md., U. S. A., 1896. 234 pages. 5 by 7½ inches. (Not standard size.)

As its title indicates, this book is a list of gears, pulleys, etc., for which the Robert Poole & Son Company have paterns, and which they can therefore furnish on short notice. The patterns are classified according to pitch and the tables give all the essential dimensions of each gear and pulley. The list includes spur, level and mitre gears of many sizes; mortise gears, spur, face and bevel; worms and worm gears; wheels for wire-rope transmission; sheaves for ropes and chains; band, rope and fly wheels; and pulleys for belt transmission. While the list of gears contains only the sizes for which the company has patterns, the system of machine-molding employed at their works enables them to make almost anything in the gear line of one inch pitch or over, with but little expense for preparation. The reputation of this company's machine-molded gears is thoroughly established and not the least of their merits is the excellent material put into them. The company's facilities enable them to make gears up to 50 feet in diameter. The company also has facilities for making cut gears of all kinds up to the same size. This concern makes the Poole-Leffel double-turbine water-wheel, patent friction clutches, shaft hangers, thrust bearings, etc., all of which are illustrated in this catalogue, though some of them are more fully described in other pamphlets issued by the company.

THE MOST ECONOMICAL BRAKESHOE. The Schoen Brakeshoe Company, Betz Building, Philadelphia, Pa. 8 pages. 6 by 9 inches. (Standard size.)

This pamphlet illustrates and sets forth the advantages of the pressed-steel brakeshoes made by the company. The tests of the brakeshoe committee of the Master Car Builders' Association are quoted to show that soft pressed-steel shoes rate very highly in their wearing qualities and holding power. They are claimed to wear 10 times longer than cast-iron shoes, to be capable of being worn thinner, thus giving more useful wearing material per shoe, to hold with a nearly uniform retarding power, to heat less rapidly than other shoes, to necessitate less frequent adjustment of the brakes, to wear the wheels less than cast-iron shoes, and to effect a saving of from 50 to 75 per cent. in the outlay required for brakeshoes. To substantiate these claims the company can point to the experience gained in three years of service. The shoes are made by hydraulic pressure by a process that permits the use of very soft steel, and the form and dimensions of the present standards are duplicated with great exactness.

WATERMAN'S IDEAL FOUNTAIN PEN. L. E. Waterman Company, 155–157 Broadway, New York. 16 pages. 5 by 6½ inches.

This catalogue illustrates the various sizes and styles in which this, the best of fountain pens, is made. It contains many testimonials as to its excellence, beginning with the opinion held by Mr. Chauncey M. Depew, who says: "I am still using your incomparable fountain pen. Since I bought my first one in July, 1886, it has been my constant and faithful companion." We would take this opportunity to add our testimony to that of others who have used this excellent pen. We have now used this pen for four years, and in all that time it has never failed us. It has always made its mark on the first stroke and given no trouble in feeding. To those who have had trouble with fountain pens that won't feed or that feed too much, we would advise a trial of the Waterman. With the most ordinary care they will be found always ready and will always write smoothly.

The Fourth Annnal Report of the Michigan Peninsular Car Company.

The fourth annual report of the Michigan Peninsular Car Company, of Detroit, is an interesting document. This large concern, formed by a consolidation of several interests four years ago, has a plant comprised of two complete car-building establishments, one car-wheel foundry, a forge and iron works, and a pipe plant, the total valuation being $7,720,536. The report shows that during the year the company spent $24,478, in additions to its plant, and that its total assets on Aug. 31, 1896, was $10,429,791.49. The preferred capital stock is $5,000,000, common stock $3,000,000 (of which $1,000,000 is unissued) and there are first mortgage bonds to the extent of $2,000,000.

During the year ending Aug. 31, 1896, the company paid the interest on the bonds and also dividends of $200,000 on the preferred stock, and then had a surplus on the year's business of $96,571.84. Like that of all other manufacturing concerns its business for the last four years shows great fluctuations. The figures prove, however, that the plant of the company can be operated with good profits when work is obtainable to keep it going, as is evident from the following statement of earnings from all sources for the four years commencing Sept. 1, 1892, and ending Aug. 31, 1896:

1st year	$866,690.66
2d year	30,024.38
3d year	159,231.98
4th year	396,571.84
Total	$1,458,517.86

During the first year of this period the company paid $400,000 dividends (8 per cent.) on the preferred stock and $160,000 on the common stock. Of course, with the depressed condition of business in the second and third years, the earnings did not suffice to pay the interest on the bonds, but in the last year dividends have been resumed and the company stands ready, with a large and efficient plant and considerably more than a quarter of a million surplus, to take advantage of the improvement in business to be expected after the election has given business men the assurance of a sound currency.

Graphite Paint for Metal Work

Engineers are giving much more attention now than formerly to the paints employed in the preservation of structural iron and steel from corrosion. Undoubtedly the large use of steel in fireproof buildings where it is not accessible after the buildings are complete has been an important factor in stirring up this interest. The protection of such surfaces from corrosion is certainly a matter of moment. It is of vital importance in the case of fireproof buildings, and in all structures a suitable protective coating is a source of economy. Roofs and bridges, while accessible for re-painting, are made more durable at less expense by a coating that is lasting and does its work thoroughly than by one that needs frequent renewal. In our article on steel cars in France, published in our August issue, it was shown that the protection of a good paint applied frequently enough to keep the surface covered at all times added many years to the life of the cars. And so many other cases might be cited which in part explain the present interest in protective paints for iron and steel.

The possible chemical action between the pigment and the oil, and its effect upon the surface it covers have been studied carefully and the opinion is now held that some paints actually promote oxidation of the metal. But however truly this may apply to some paints it is not true of all them, and those known as graphite paints are certainly free from any tendency to chemical action between their constituents, and show remarkable resistance to chemical action from without. "Superior" graphite paint manufactured by the Detroit Graphite Manufacturing Company, of Detroit, Michigan, has established itself in the confidence of engineers by the excellent record it has given in actual service. The graphite entering into this paint is mined by the company in Northern Michigan. Mixed with an oil and free from acids, it is chemically inert, and in drying forms a coat that adheres firmly to the metal surface. Its resistance to the action of acids and alkalis has been proven by numerous tests much more severe than the conditions of service, and its resistance to the penetration of moisture have been equally satisfactory. Heat does not cause it to blister, and we are informed that steel chimneys painted with it have been heated to redness without affecting the paint. The viaduct by which the Canadian Pacific and Wabash roads enter Detroit is painted with "Superior" graphite paint, and after two years service is still in excellent condition. A fire in neighboring flour sheds played upon the ironwork for two and one-half hours without blistering the paint, This fact is attested by Mr. J. E. Smith, superintendent of terminals, who in the same letter also says that the smoke and fumes from Michigan Central locomotives, which pass under the viaduct at one point, have had no effect upon the paint.

The paint has been used with success upon the hulls and decks of steel steamers, and there seems to be no conditions of service which it does not successfully meet. Those who would use it in places where its natural color is undesirable, can have a choice of several colors and shades. The Detroit Graphite Manufacturing Company use every care in the manufacture of the paint. The fineness of its particles give it excellent covering qualities and cause it to apply evenly.

A Commercial Travelers' Fair.

A commercial travelers' fair is to be held in Madison Square Garden, New York, Dec. 15 to 28. Its aim is to raise $150,000 to complete the National Home for commercial travelers or their dependent families, at Binghamton, N. Y. It is the intention of those in charge to make the fair one of the best attractions of the year. Mayor George E. Green, of Binghamton, is President of the Commercial Travelers' Home Association, and is the Treasurer of the fair. Col. A. B. de Freece, Director-General of the fair, has proposed that upon Tuesday, Dec. 1, in every city of more than 10,000 inhabitants, the hotels, theatres and leading stores will devote a percentage of the day's receipts to the Fair Home building fund. Mr. Allen S. Williams has been elected Chairman of the Commercial Travelers' Day Committee. The Honorary Committee of the fair, which is presided over by the Hon. Chauncey M. Depew, comprises over 1,200 leading men in the United States, representing almost every principal locality important in traffic, producing or manufacturing. The only detail necessary to the perfect working of the plan for a Commercial Travelers' Day (which is to be a feature of the fair) is for the hotels, theaters and stores desiring to share in the philanthropy, honor and pecuniary benefit of the occasion to promptly notify Chairman Allen S. Williams at Madison Square Garden, New York, of their desire to remit the cash results on Dec. 2, in a New York bank draft payable to George E. Green, Treasurer, or to Director General A. B. de Freece at Madison Square Garden, New York.

Wm. Skinner & Son, of Baltimore, have received an order from the Baltimore & Ohio for 10 freight lighters for use in New York Harbor.

The American Brake Beam Company has orders for 4,000 Kewanee beams for the Erie cars being built by the Michigan-Peninsular Company.

The Niles Tool Works has an order from the Government for eight carriages for 10-inch disappearing guns. This equipment is for coast defense.

The Lidgerwood Manufacturing Company, 96 Liberty street, New York City, has opened a branch office at New Orleans in the Hennen Building, in charge of J. H. Dickinson.

The report that the plant of the Cambria Iron Company, at Johnstown, Pa., had closed for an indefinite period is denied. The plant resumed operations on the 12th of last month.

The West Shore Railroad has placed a contract with the Harlan & Hollingsworth Company, of Wilmington, Del., for a steel hull ferryboat for use on the North River. The boat is to be 250 feet long.

Mr. C. R. Brown, formerly with the Illinois Steel Company, has entered the Western department of the Lappin Brake Shoe Company, and has offices with Mr. F. P. Collier, the Western Manager for the company, in the Rookery Building, Chicago.

Prince Hilkoff, Russian Minister of Ways and Communication, who has been in this country studying American railroad operation, has sailed for Europe. It is said that before sailing he placed orders for 18,000 American watches for the use of the trainmen on Russian railways.

At the last meeting of the Board of Directors of the Bloomsburg Car Manufacturing Company, Bloomsburg, Pa., a change in the Presidency was made, Mr. G. M. Lockard having sold his interest

in the company to Mr. L. S. Wintersteen. The latter gentleman was made President. The works are at present busy filling orders for Japan and South America.

The Bloomsburg Manufacturing Company, Bloomsburg, Pa., had a part of its main building blown down in the severe storm of Oct. 1, and the roofs of the boiler-house and muffle-room carried away. Rebuilding and repairs were at once commenced and now the mill is in full operation.

The Shoenberger Steel Company, of Pittsburgh, has awarded contracts to the Ball Engine Company, Erie, Pa., and to the Siemens-Halske Electric Company, New York, for an electric power plant, consisting of one 400 and one 150 horse-power vertical compound engine, direct connected to 225 kilowatt and 100 kilowatt generators.

George P. Nichols and Brothers, 1325 Monadnock Building, Chicago, announce their appointment as general sales agents for the Western States of the J. H. McEwen Manufacturing Company, of Ridgway, Pa., manufacturers of the McEwen automatic engine, simple and compound; also the Thompson-Ryan generator for electric railway, power and lighting plants, belted and direct connected.

Messrs. Riehle Bros. Testing Machine Company have shipped to the Sormovo Co., Nijni Novgorod, Russia, a 100,000-pound automatic and autographic testing machine and also a specimen miller. They have also placed 200,000-pound testing machines at the works of the Schoen Pressed Steel Company and Jones & Laughlins, Pittsburg. They are also building a large 300,000-pound wire rope testing machine for John A. Roebling's Sons Co., Trenton, N. J.

The American Stoker Company, of Dayton, O., has recently perfected a steam motor which is applied to each stoker, thus making each machine independent. This renders the work of installation very simple. It also renders the stoker practicable for use under Marine boilers. This company is desirous of a general representation through engineering firms handling pumps, heaters and boiler-room supplies, and invites correspondence from interested parties.

The Ingersoll-Sergeant Drill Co. have placed an air-compressor in the engine-room of the Havemeyer Building, New York City, and compressed air will be supplied to tenants in the building who desire it. The company's offices are in this building and it will employ air to operate appliances of all kinds on exhibition in its offices. This will include machinery, tools, letter-presses, etc., while the same agent will be used to dust the furniture, clean carpets, ring call-bells, open doors and in general display its usefulness and utility.

The Peerless Rubber Manufacturing Company of New York has added a 320 by 40 feet extension to its works. The building is three stories high and practically doubles the capacity of the plant. The capacity of the Peerless plant is now $2,000,000 worth of mechanical rubber goods per annum. In the new factory are four 200 horse power of water tube boilers and one 500 horse power Corliss engine. Among other machinery it contains one of the largest belt presses in the world, it being 30 feet long, 60 inches wide, with double plates and double stretchers.

The Borden & Selleck Company, Lake street, Chicago, Ill., reports a fairly active business in its coal and ash handling machinery. Among plants recently put in operation are: Ash and soft coal handling conveyors for two power-houses of North Shore Electric Company (Chicago); soft coal conveyors, steel storage tanks, etc., for carrying coal from a side-track through a tunnel under street and factory, delivering same into battery of boilers, for Jas S. Kirk & Company, soap makers, Chicago. A contract has just been closed with the Chicago Public Library for anthracite coal and ash-handling machinery for the new library building.

Notwithstanding the dull times the New York Belting and Packing Company has within the last few weeks taken orders for interlocking rubber tiling for three prominent hotels in New York City, a well-known club in Cincinnati, 32 dining and sleeping cars, one steamship and one United States battleship. The first lot of tiling the company laid was in the Broad Street Depot of the Pennsylvania Railroad, in Philadelphia. After two and one-half years of wear, with an average of 50,000 people passing over it each day, the tiling has worn down only one-sixteenth inch, and that only in spots where most of the travel is concentrated. Not a cent has been spent for repairs since it was laid. We saw this tiling less than a week ago and it was noticeable for its freshness of color and perfect condition generally. The tiling is remarkably pleasing in appearance when new and loses none of that attractiveness as it wears. It gives a good foothold, does not wear slippery, and, in fact, it retains all of its good qualities unimpared throughout its life. It should be investigated by those who desire a durable and artistic covering for floors, stair landings, decks, etc.

Florida and Western North Carolina.

The climate is nearer perfection than that of any other place on earth. The time is fast approaching when numbers will desire to seek a milder climate. Where shall you go? The Southern Railway, "Piedmont Air Line," the great Southern trunk line, offers numerous attractive resorts located upon and reached by this great system of railways, all reached from New York in Pullman's finest vestibuled trains, giving all the comfort and conveniences that are required by the demand of the traveling public. If you are contemplating a trip and want descriptive literature or any information regarding the winter resorts South, call on or address General Eastern Office of the Southern Railway, 271 Broadway, New York.

Our Directory

OF OFFICIAL CHANGES IN OCTOBER.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Altoona, Clearfield & Northern.—President F. G. Patterson has been appointed Receiver.

Brooklyn Beach.—Mr. E. L. Langford has been chosen President, vice J. Jourdan.

Chicago, St. Paul, Minneapolis & Omaha.—Mr. Walter A. Scott has been appointed General Manager, with office at St. Paul, vice Mr. H. G. Bent, resigned.

Chicago & Northwestern.—Mr. Horace G. Bent has been appointed Third Vice-President, vice Mr. W. H. Newman, resigned.

Charleston & Western Carolina.—This corporation is the successor of the Port Royal & Augusta.

Interoceanic of Mexico.—Mr. G. M. Stewart has been appointed General Manager.

Illinois Central.—Mr. F. W. Brazier has been appointed Assistant Superintendent of Motive Power, with office in Chicago.

Louisville, Evansville & St. Louis.—Mr. J. F. Lechler has resigned as Master Mechanic at Princeton, Ind., and is succeeded by Mr. F. C. Cleaver. Mr. W. W. Wentz, Jr., is Secretary and Purchasing Agent, with office at Louisville.

Minneapolis & St. Louis.—Mr. Edwin Hawley has been chosen President, to succeed Mr. W. L. Bull, resigned.

Missouri, Kansas & Texas.—Mr. J. L. Wigton has been appointed Master Car Builder of lines north of Denison, with headquarters at Sedalia, Mo. Mr. W. H. Brehm has been appointed Master Mechanic over the same lines, with headquarters at Parsons, Kan.

Manitou Beach.—Mr. F. J. Sarnon, formerly Master Mechanic, has been made Superintendent, vice Mr. G. C. Mills. Mr. Chas Sarnon is appointed Master Mechanic.

Mexican National.—Mr. E. D. Stegall has been appointed Master Mechanic at Acambaros, Mex. Mr. E. W. Knapp, formerly at Acambaro, has been transferred to Mexico City.

Northampton & Hertford.—G. H. Clark, Jr., has been elected Vice-President, with office at Newark, N. J., vice A. L. Shepherd, deceased.

Norfolk & Western.—The Receivership was abolished Oct. 1. Mr. Henry Fink is President and Mr. F. J. Kimball Chairman of the Board of Directors.

New Orleans & Western.—Mr. W. Mason Smith has been chosen President, vice Mr. Chas. E. Levy, resigned. Mr. W. W. Pierce has been chosen Vice-President, vice Mr. W. Mason Smith.

Ogdensburg & Lake Champlain.—H. Walter Webb has been appointed Temporary Receiver.

Oregon Improvement.—Mr. L. H. Hawkins has been appointed Chief Engineer, with office at Seattle, Wash.

Pullman Palace Car Co.—Gen. Horace Porter, first Vice-President, has resigned, and is succeeded by Mr. G. H. Wickes, formerly second Vice-President.

Pittsburgh & Lake Erie.—Mr. J. A. Atwood has been appointed Chief Engineer.

Wheeling & Lake Erie.—Mr. W. H. Stark, Master Car Builder has resigned.

PRESSED STEEL TRUCK FRAMES

AND PRESSED STEEL PARTS FOR CAR AND TRUCK CONSTRUCTION.

FOX SOLID PRESSED STEEL CO { GENERAL OFFICES: Fisher Building, 281 Dearborn St., Chicago. WORKS: Joliet, Illinois.

JAMES S. BRADY, GENERAL SALES AGENT, HAVEMEYER BUILDING, NEW YORK.

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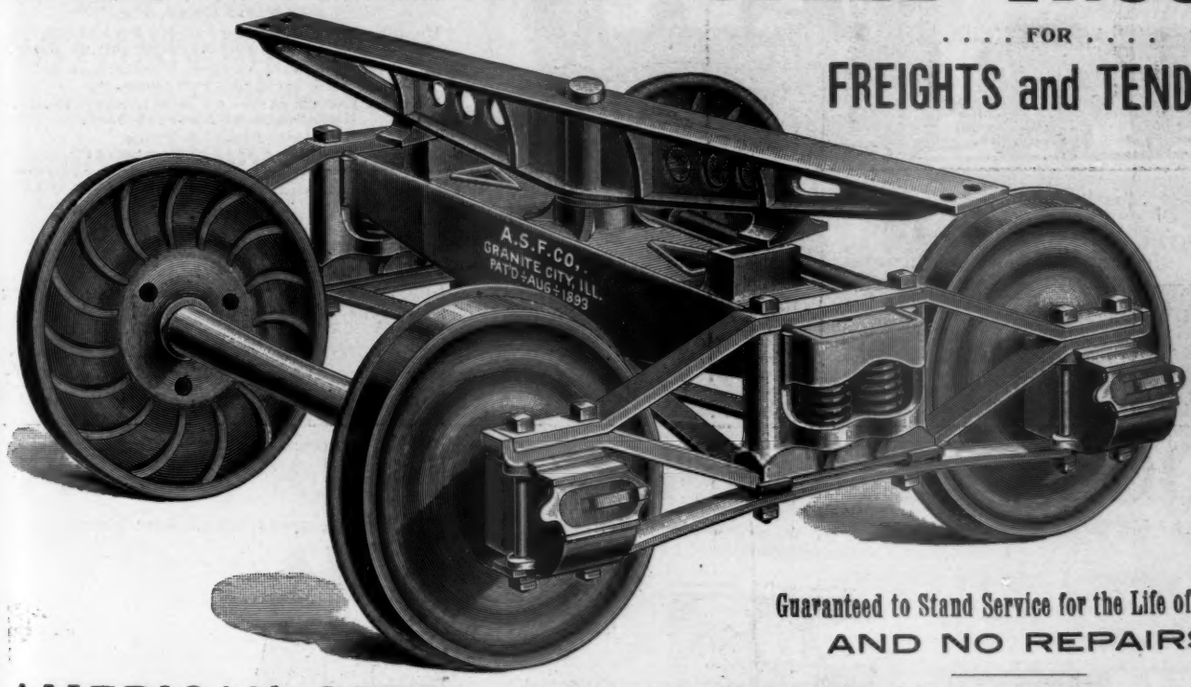

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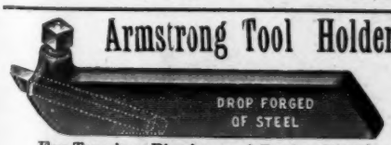

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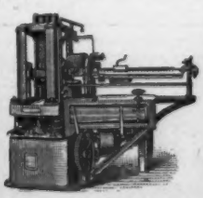

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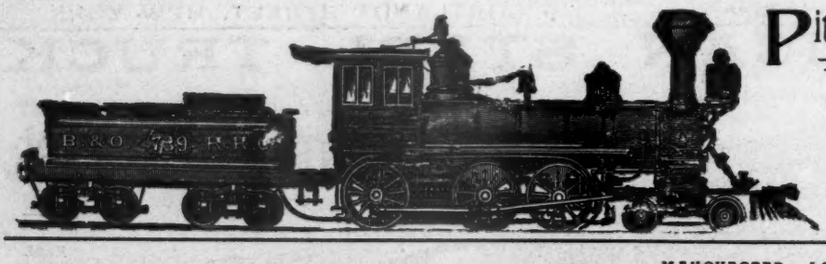

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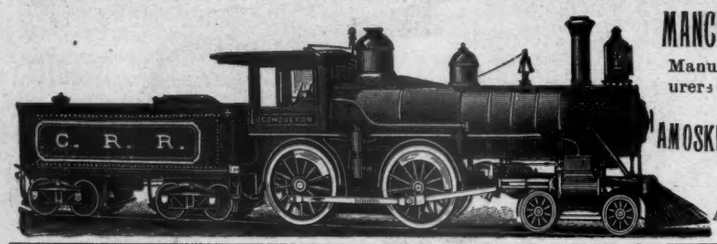

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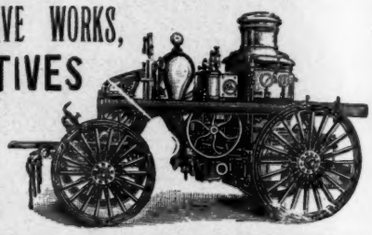

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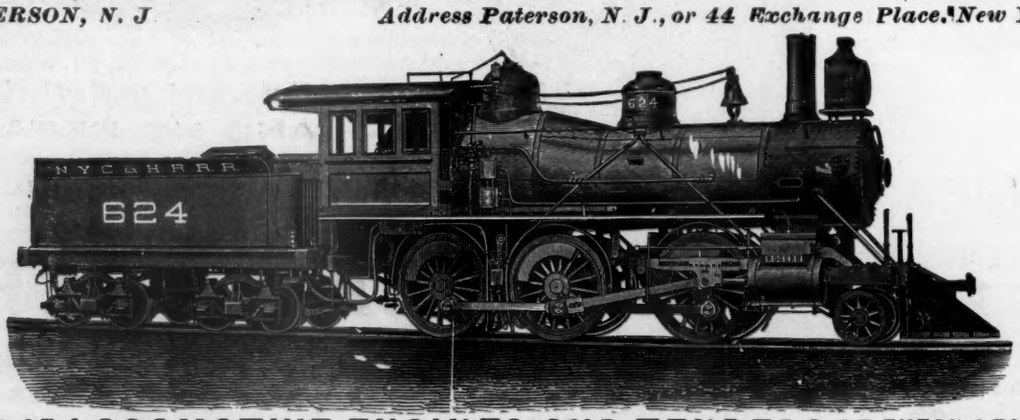

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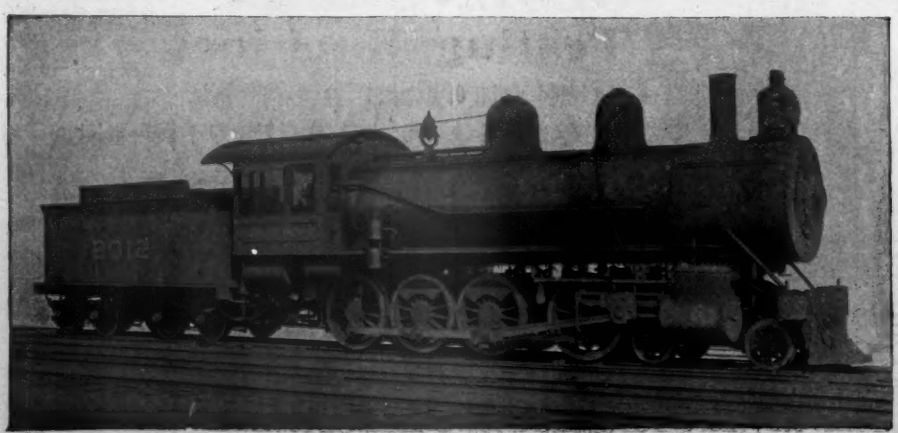

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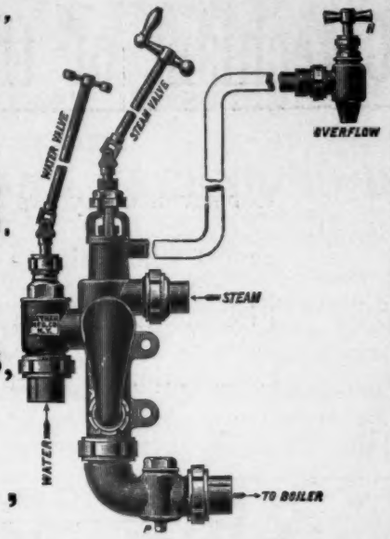

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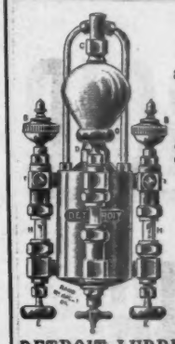

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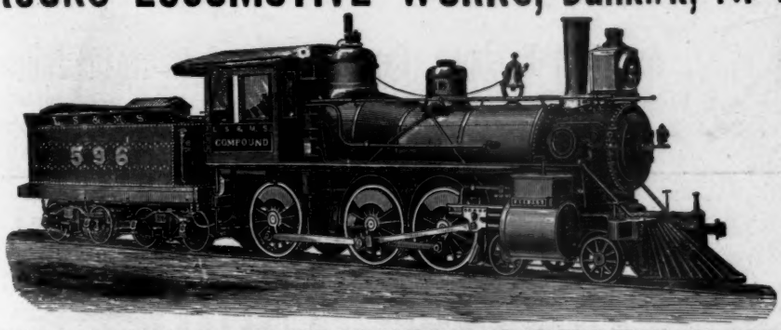

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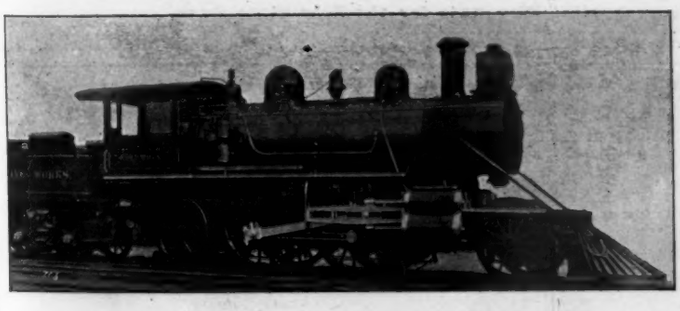

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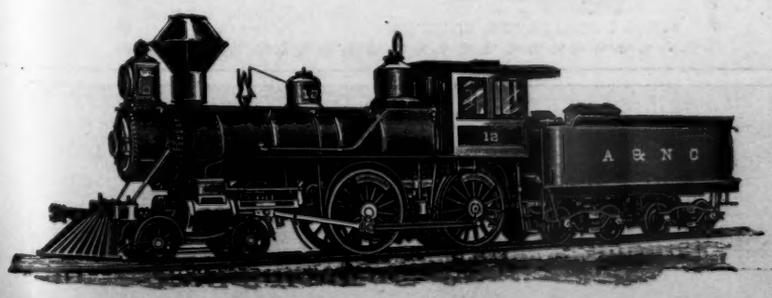

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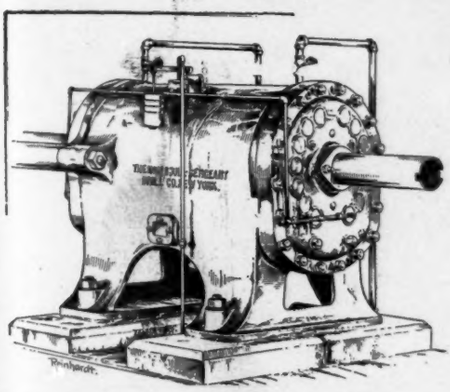

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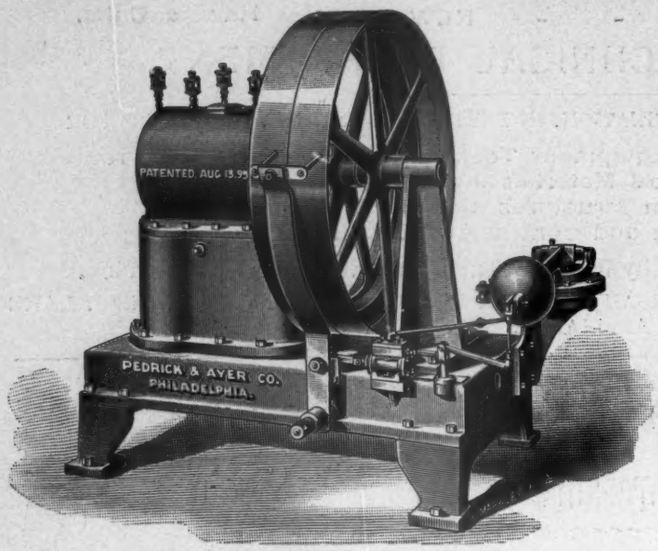

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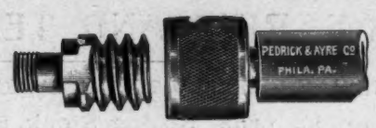

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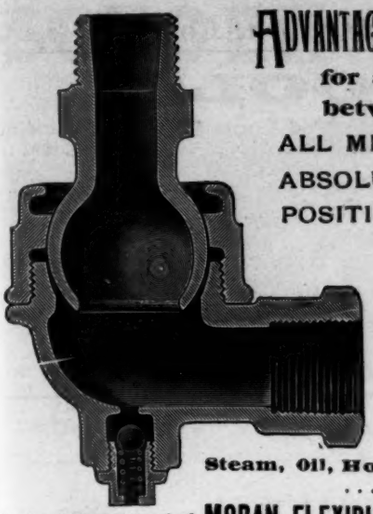

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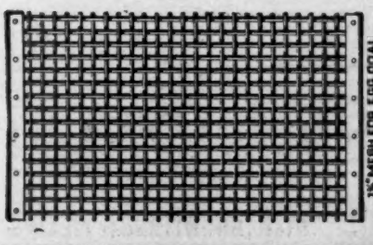

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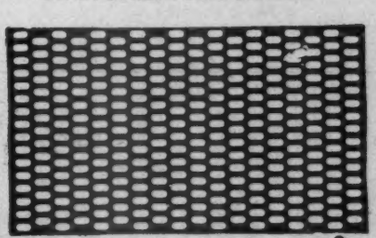

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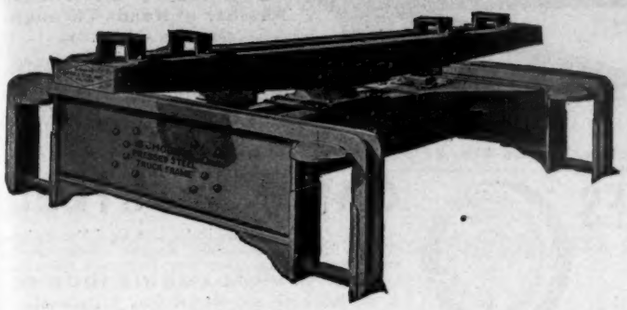

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